CONTRACT REQUIREMENTS	CONTRACT ITEM	MODEL	CONTRACT NO.	DATE
Exhibit E, Par. 3.2	020	LEM	NAS 9-1100	1-14-63

TYPE I DATA
NASA APPROVAL PENDING

Primary #851

REPORT

NO. LPL-611-2 DATE: 1-6-64

REQUIREMENTS FOR WSMR SUPPORT
OF THE
LEM/LITTLE JOE-II TESTS [U]
(GAEC - RFWAR)

CODE 26512

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REVISIONS

DATE	REV. BY	REVISIONS & ADDED PAGES	REMARKS

CLASSIFICATION CHANGE
To UNCLASSIFIED
By authority of GAEC-RFWAR
Changed by L. Shirley Date 11/30/72
Classified Document Master Control Station, NASA
Scientific and Technical Information Facility

CONFIDENTIAL

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INTRODUCTION (U)

The NASA/MSC, as the range user for the LEM/Little Joe II tests, must provide the WSMR with the requirements for support of the tests. These requirements are then published by the WSMR in "The Requirement for Work and Resources". The latter is the principal support planning document for all programs utilizing WSMR facilities and must be authenticated and accepted by the commanding general of WSMR before any element of the WSMR may take action on any user requirement.

This report has been prepared to assist the NASA in informing the WSMR of the support requirements for the LEM/Little Joe II tests. The format used is that established by WSMR Regulation 705-9 dated 17 January 1963 in order to facilitate use by both the NASA/MSC and the WSMR.

The following information is provided to assist the NASA/MSC and the WSMR in applying the information presented:

1) The LEM-1 and LEM-2 flights will have the same support requirements though the trajectories will differ slightly. This report contains only a single Section II to describe both flights. Individual Section II's will be provided as the flight planning progresses.

2) The Little Joe II has a fin area of 50 ft^2. Wind tunnel testing of the LEM/Little Joe II configuration has indicated that the fin area must be increased to 100 ft^2. The increase in fin area requires a re-evaluation of the test sequence in conjunction with optimization of the trajectories. A study to accomplish the latter is not complete. In order to facilitate early planning, this report presents preliminary trajectories for 100 ft^2 fins. These trajectories supercede those contained in previous reports (i.e. GAEC Report No. LPL-610-1 and LPL-611-1), but are for WSMR planning purposes only. Final trajectories will be furnished upon completion of optimization study.

3) The flexibilities of launch angle (±15° from vertical) and aximuth (±45° from true north) were used in an effort to confine the impact dispersions within the boundaries of the WSMR and ABRES (BMRS) Safety Tract No. 4. The angles chosen may be changed if WSMR desires other impact areas.

4) The security classification of each subparagraph is indicated in the parantheses after each paragraph number. The following letters have been used:

(U) Unclassified

(C) [redacted]

RFWAR No.

Submitted by NASA Manned Spacecraft Center

SECTION I - General Information

A.- Identification and Relationships

1.- Designation

a.- (U) Name of Project - Apollo/LEM
b.- (U) Unclassified Short Title - LEM/Little Joe Sub-orbital Flight Tests.
c.- (U) Authority - NASA Contract NAS 9-1100
d.- (U) Priority - Unknown
e.- (U) User Priority - Unknown

2.- Related Projects

a.- (U) Existing projects known - Apollo Mission Abort Testing
b.- (U) Existing projects possible - unknown
c.- (U) Future projects possible - unknown

3.-(U) Purpose of this RFWAR

This RFWAR is furnished for necessary action.

4.- Agencies and individuals authorized to add to or revise this RFWAR.

a.- (U) The WSMR will act only on information received from NASA Manned Spacecraft Center and addressed to the Commander. The individuals from NASA authorized to add to or revise this RFWAR will be supplied by the NASA/MSC.

b.- (U) Any changes to this RFWAR that the NASA contractor personnel may have will be sent through the NASA/MSC, WSMR Resident Managers Office for coordination and approval. The WSMR should act on the most recent information received from the NASA and shall act on information received from the local representative before it is authenticated only when immediate action is required to prevent delays in testing.

5.-(U) Government Organization and Pertinent Personnel

This information will be provided by the NASA.

6.-(U) Contractors

a.- (U) Prime Launch Vehicle Contractor: Program Manager
J. B. Hurt (Mail Zone 6-110)
General Dynamics/Convair
P.O. Box 1950
San Diego 12, California
Cypress 6-6611, Ext. 1967

6.- Contractors (cont'd)

b.- (U) Prime Spacecraft Contractor:

Test & Support Manager - Pl. 25
T. H. Moorman
Grumman Aircraft Eng'g. Corp.
Bethpage, Long Island
New York 11714
516-LR-5-2924

c.- (U) Major Sub-Contractors:

(1) (U) Shroud & Adapter

Program Manager
J. B. Hurt (Mail Zone 6-110)
General Dynamics
P.O. Box 1950
San Diego 12, California
Cypress 6-6611, Ext. 1967

d.- (U) Local Responsible Contractor:
Personnel:

J. H. Semcken
Test & Support - Plant 25
Grumman Aircraft Eng'g. Corp.
Bethpage, Long Island
New York, 11714
516-LR-5-1521
(Temporary address until facility is manned.)

7.- Local Project Personnel

a.- (U) NASA Apollo Resident Manager: Wesley F. Messing
White Sands Missile Range

b.- (U) Grumman Liaison: Harvey C. Gerhard
White Sands Missile Range
Building 108

8.- (U) Security Classification

The security classification assigned to these tests can be found in the NASA Project Apollo Spacecraft and Flight Missions, Security Classification Guide, SCG-11, dtd. April 16, 1963.

B.- Characteristics

1.- Physical

a.- (U) The dimensions of the LEM/Little Joe launch configurations are shown in figure 1.

b.- (C) Weight (fueled, empty, w/wo booster)

	LEM	Shroud & Assembly	Little Joe	Launch
fueled	23,626 lbs.		165,549 lbs.	193,675
empty	5,611 lbs.	4,500 lbs.	32,395 lbs.	42,506

Code 26512 Eng-23A

B.- Characteristics

1.- Physical (cont'd)

c.- Outer Skin (Material and Reflectivity)

(1) (U) LEM and Shroud - The LEM and shroud will have aluminum outer skin with appropriate paint patterns to facilitate visual tracking.

(2) (U) Little Joe - The Little Joe skin is truncated form corrugated aluminum alloy sheets. Appropriate paint patterns will be provided for data acquisition reference.

d.- (C) Engines (type, fuel used, size, weight, thrust, duration)

The LEM system uses pressure-fed, hypergolic, liquid, bi-propellant rocket engines for propulsive thrust and vehicle stabilization. The propellants used are Aerozine 50 and nitrogen tetroxide. A summary of the detailed engine characteristics listed in Table I is shown below.

Engines	No.	Thrust	Weight	Duration
Ascent	1	3500 lbs.	131 lbs.	445 sec.
Descent	1	variable 1050-10500	358 lbs.	730 sec.
Reaction Control	16	100 lbs. each	4.4 lbs. each	1452 sec. each

e.- (U) Booster (type, fuel used, size, weight, thrust, duration)

The booster will be the Little Joe II model 12-51. Seven Algol-ID, solid propellant motors will provide the boost thrust. The characteristics of the motors are listed in Table II.

f.- (U) Scale sketch of launch vehicle with spacecraft side and tail view.

A scaled sketch is given in figure 1.

g.- Launch Vehicle and Spacecraft System Equipment

(1) (U) Launch Equipment - The launch is to take place from the Little Joe facilities on the WSMR A.L.A. 3 site. The launcher used for previous Little Joe flights will require modification to the umbilical mast to allow for the payload diameter (212") which exceeds the booster diameter (154") and to accommodate the LEM umbilical. The LEM umbilical will contain water glycol fluid lines, instrumentation hard lines, electrical power supply lines and lines for other electrical services. (i.e. platform alignment).

B.- Characteristics

1.- Physical (cont'd)

g.- Launch Vehicle and Spacecraft System Equipment

(1) (U) cont'd - The service gantry will require modification. The service platforms must be adjusted to the working levels required by the LEM, the clearance holes in the platforms must be enlarged, and the handling and safety provisions required for toxic hypergolic fuels must be installed.

More detailed requirements for changes to the launch complex will be supplied as they become known.

(2) (U) Ground Guidance - N/A

(3) Airborne Guidance -

(a) (U) Attitude - Following separation from the booster, the LEM will be attitude stabilized with the thrust axis aligned with the local vertical at launch. This stabilization will be maintained during tests of the ascent and descent propulsion systems. Subsequent to ascent engine cutoff, the vehicle will be permitted to rotate through small angles as it free falls toward the earth.

(b) (U) Destruct - The destruct system for the Little Joe II launch vehicle will provide the Range Safety Officer with an RF system for terminating thrust.

The destruct system on the LEM will provide the Range Safety Officer with an RF system for dispersing the propellants at any time subsequent to launch.

(4) (U) Checkout - The LEM spacecraft will arrive at Holloman AFB. It will be transported to the NASA Propulsion System Development Facility for checkout. During the checkout the vehicle will be moved to the Vehicle Assembly Building in launch area A.L.A. 3 on the range and then will be mated to the booster on the launch pad for Little Joe. A checkout sequence which indicates the general vehicle flow is illustrated in figure 2a through 2c.

(5) (U) Ancillary (description) - A preliminary indication of the type of GSE to be used is given in the checkout sequence (figure 2a through 2c).

B.- Characteristics

1.- Physical (cont'd)

g.- Launch Vehicle and Spacecraft System Equipment

(6) Stability Methods

(a) (U) Little Joe II Booster - The Little Joe II, model 12-51, is stabilized in an attitude hold mode. The autopilot, which senses three axis angular deviations and angular rates, commands the position of elevons on each fin and operates a hydrogen peroxide reaction control system.

(b) (U) LEM - An inertial platform will provide an attitude reference. The attitude errors will be used to operate 16 reaction control rockets which stabilize the LEM about all three axes. The thrust axis (X) will be maintained parallel to the local vertical at the launch site. The Y & Z axes orientation will be determined by mating considerations with the booster, shroud, and adapter.

2.- Tactical

a.-(C) Type - The LEM/Little Joe flights are sub-orbital with impact planned on the WSMR.

b.-(C) Purpose - The purpose of the LEM/Little Joe flights is development testing of the LEM propulsion systems in the zero "g", hard vacuum, and unrestrained vibration environments of space.

c.-(U) Specification - N.R.

d.-(C) Description of overall systems operation - The launch will take place from the A.L.A. 3 area of the WSMR. Four Algol motors will be ignited at t + 0 to provide the initial thrust. These will be followed by ignition of the remaining three Algols at t + 39. Booster motor burnout is anticipated at approximately t + 83. Booster burnout will be followed by a 12 second coast to higher altitude and lower dynamic pressure. Shroud separation will occur at the end of coast followed in 2 seconds by separation of the LEM from the adapter.

LEM RCS firing to provide ullage will commence immediately upon separation from the adapter and the vehicle will be rotated and stabilized with the LEM thrust axis along the local vertical established prior to launch. The descent engine will be started and the LEM descent engine tests will commence.

B.- Characteristics

2.- Tactical (cont'd)

d.-(C) Description of overall systems operation -

Upon completion of the descent propulsion evaluation, the descent stage will be separated in either an abort or lunar launch sequence (e.g. fire-in-the-hole). Ascent propulsion tests will commence immediately upon separation. At the completion of the ascent propulsion subsystem evaluation, the recoverable cameras and tape recorder will be ejected. The reaction control subsystem will then be evaluated as the vehicle free falls toward the earth.

No provisions are made to soft land the LEM stages. Recovery of the stages is not a requirement at this time.

e.- Performance (identify with phases of flight) - The flight parameters for the LEM-1 test which emphasizes evaluation of descent propulsion, and for the LEM-2 test which emphasizes ascent propulsion and RCS evaluation will be different. It is anticipated that these differences will be primarily in the test and that the trajectory will be approximately the same. The LEM-1 flight parameters are given below for early planning. The LEM-2 parameters will be provided at a later date.

Event	Parameter
(1) (C) Booster Engine Cutoff	Mach No. 3.95 Altitude (151,500 ft.) Velocity (4,340 ft/sec) Dynamic Pressure (31.6 PSF) Range (14,500 ft.)
(2) (C) Descent Engine Cutoff	Mach No. 1.46 Altitude (486,100 ft.) Velocity (3,070 ft/sec) Dynamic Pressure (Negligible PSF) Range (232,000 ft.)
(3) (C) Ascent Engine Cutoff	Mach No. 1.16 Altitude (48,600 ft.) Velocity (3,160 ft/sec) Dynamic Pressure (Negligible PSF) Range (272,000 ft.)

B.- Characteristics

2.- Tactical (cont'd)

f.-(C) Range (max and min) - The impact dispersions for each piece of the flight vehicle are given in figures 3 and 4. Launch elevation and azimuth were varied in an attempt to maintain the impact areas within the BMRS Safety Area - Tract No. 4.

g.-(U) Reliability - This information will be provided at a later date.

h.-(C) Acceleration (min and max values) - The maximum longitudinal acceleration will be limited to 5.6 g by the design of the LEM.

i.-(C) Velocity (max and min) - The maximum velocity along the flight path is 4650 ft/sec.

j.-(C) Maneuverability - The LEM/LJ flights will be unmanned and provisions for ground control of flight path will not be included.

k.-(U) Effective area of warhead burst - N/A

C.- Ground Safety Concept

1.-(U) Little Joe II - The Little Joe II booster system will contain solid propellant rocket motors, ignitors, destruct charges on the rocket motors, and a hydrogen peroxide reaction control subsystem. The ground safety procedures used will be those developed on earlier Little Joe flights and will be supplied by the NASA/MSC.

2.-(U) LEM - The LEM system will contain small pyrotechnic devices, toxic and hypergolic propellants, and destruct charges on the propellant tanks. Standard Operating Procedures (SOP's) will be prepared by the Grumman Aircraft Engineering Corporation with inputs from NASA/MSC/WSMR Operations to define handling, installation, testing and arming procedures. The following advanced information is given as an indication of current thinking.

a.-(U) Receiving, storage, handling and delivery of pyrotechnic devices and explosive charges to the launch site and/or vehicle assembly building will be the responsibility of WSMR.

b.-(U) Installation and checkout of pyrotechnic and destruct subsystems will be the responsibility of GAEC.

c.-(U) The propellants will be transported from the NASA/PSDF to the launch site in trailers.

d.-(U) Loading of LEM propellants during final countdown will be accomplished from the service gantry through the personnel access provided in the shroud.

C.- Ground Safety Concept

2.-(U) LEM -

e.-(U) All propellant handling will be accomplished by GAEC personnel using a buddy system.

f.-(U) The launch site will be equipped with sniffers, showers, alarms, public address, first aid stations and other required safety features. Access to the site subsequent to propellant loading will be minimized.

g.-(U) All personnel to be located in the area of the launch site subsequent to arrival of the propellants shall have:

(1) (U) Completed the proper indoctrination instructions
(2) (U) Completed the required medical examinations, and
(3) (U) Have the necessary clothing and breathing protection.

D.- (U) Missile Flight Surveillence Requirements

The information required of the "Range User" by WSMR Regulation 705-3 is presented in this paragraph. The additional information required after the WSMR has accepted the project (i.e. circuit diagrams, aerodynamic coefficients, etc.) may be found in the Grumman Detailed Test Plan, Report No. Series LPL-610, or in the NASA Mission Directive for the flights. If greater detail than presented in those documents is required it will be furnished by direct coordination between the Grumman Aircraft Engineering Corporation and the WSMR.

1.-(C) Dispersion, Range, Altitude - The trajectory, associated parameters and the ground footprints for the LEM flight are presented in figures 5 and 6. The range dispersions for the various components of the launch vehicle are presented in figures 3 and 4. Figure 3 depicts the worst case (root sun square analysis) and figure 4 the root mean square of all errors. The uncertainties used to determine the dispersions were as follows:

a.-(C) Little Joe II Booster

1)	Thrust Variation	-	±7000#/motor
2)	Thrust Misalignment	-	±½ degree
3)	Gyro Drift	-	Kx=.02272 deg/sec.Ky=.001704 deg/sec
4)	Wind Prediction Error	-	50% of WSMR 84% winds
5)	Launcher Alignment	-	±½ degree azimuth - ±¼ degree elev.

D.- (U) Missile Flight Surveillence Requirements

1.-(C) Dispersion, Range, Altitude -

b.-(C) LEM

1)	Gyro Misalignment	±1 degree
2)	Thrust Misalignment	±.2167 degree
3)	Thrust Variation at max thrust	
	descent min	9830 lbs.
	max	12220 lbs.
	ascent min	3328 lbs.
	max	3832 lbs.

2.- Commanded Guidance, Turn and Pitch Rates

a.-(U) Guidance - There will be no ground guidance cpability on the LEM. A single uplink command to stage the LEM and commence ascent engine testing is planned if a descent engine failure is experienced.

b.-(C) Turn and Pitch Rate - The LEM system is limited, in normal operation, to maximum rates of ±10 degrees per second on all three axes.

3.- Flight Safety

a.-(U) Little Joe II - A dual, command destruct subsystem is installed to terminate the Little Joe thrust. The pyrotechnic subsystem consists of two destructors, two primacord trains, and destruct charges attached to the Algol motors.

b.- LEM

(1) (U) Propellant Dispersion - It is presently planned that a mechanically armed pyrotechnic subsystem will disperse the LEM hypergolic propellant if a failure is experienced at any time after lift-off.

(2) (U) Component Impacts - The launch vehicle will divide into several components during the test. The individual components will be the Little Joe II booster plus the LEM adapter, the LEM shroud (2 pieces), the LEM descent stage, the LEM ascent stage, two recoverable camera packages, and a recoverable tape recorder package. The impacts of the major components were discussed in Section I.D.1 of this RFWAR. Predicted impacts for all components will be supplied at a later date.

E.- Schedule of Effort

1.-(C) Advance Planning Phase

The planning for the test is currently in progress. The LEM hardware is presently scheduled for WSMR as follows:

	Arrive NASA/PSDF	Arrive WSMR	Launch
*QTV		October 1965	February 1966
LEM-1	April 1966	June 1966	August 1966
**LEM-2	June 1966	August 1966	October 1966

NOTE: *The QTV flight will have mass and inertia simulation of the LEM payload. The launch date should be earlier than that shown, if possible. NASA/MSC will establish the firm dates.

**LEM-2 will remain at the NASA/PSDF until LEM-1 has been launched.

2.-(U) Detailed Planning Phase

The WSMR Support Summary Chart is presented on page 56.

SECTION II RANGE REQUIREMENTS

The LEM-1 and LEM-2 flights are similar in characteristics. The information presented in this issue of the RFWAR is applicable to both flights. The individual requirements for each flight will be supplied as planning progresses.

A.- General Test Information

1.- Description and Objectives

a.-(C) Designation of type of test - The LEM/Little Joe II flights will be unmanned, suborbital propulsion development flights.

b.- Description and Objectives of Test

(1) (U) Description - The mission is described in Section I.B.2.d of this RFWAR.

(2) Objectives

(a) (C) The primary test objectives are:

Evaluate and certify the safe operation of the ascent/descent and reaction control propulsion subsystems.

Evaluate the dynamics of the LEM ascent/descent stage separation for the fire-in-the-hole condition.

Evaluate the thermal effect of a fully expanded descent engine plume on a simulated landing leg.

Evaluate the pressure environment of the ascent engine nozzle and the thermal distribution on the ascent/descent stage interface during the fire-in-the-hole condition.

(b) (C) The secondary test objectives are:

Demonstrate the LEM system structural integrity subsequent to boost.

Evaluate the LEM engine induced environments.

Demonstrate the staisfactory performance of the command system.

Demonstrate the LEM umbilical separation during shroud separation.

Demonstrate the compatibility of the applicable GSE.

A.- General Test Information

1.- Description and Objectives

(2) Objectives

(c) (C) Purpose and use of data - The satisfactory completion of the tests and analysis of the data are required to certify the safe operation of the LEM propulsion systems in the space environment preparatory to conducting manned LEM space flights. The pictorial coverage, launch pad measurements, and tracking data which will be used primarily for range safety, will also provide background data for analysis of the telemetered results, and for the planning of subsequent flights.

(d) (U) Launch and Impact -

Launch - It is planned that the Little Joe launch site in WSMR A.L.A. -3 be modified to accept these tests. A description of the modifications is give in Section I.B.1.g.1 of this RFWAR.

Impact - The LEM/Little Joe II launch vehicle will divide into several components during flight as discussed in Section 3.D.2. The impact dispersion of the major components are presented in Section I.D.1 of this RFWAR.

B.- Trajectory and Associated Data Requirements

A right hand Cartesian coordinate system with the origin at the launch point should be used for presentation of the trajectory and associated data. The Y axis will be positive true north, the X axis will be positive east and the Z axis will be positive upwards. The XY plane will be tangent to the launch point.

The units of measure for the test shall be feet, degrees, seconds and pounds.

1.- Firing and Flight Data

a.-(U) Launcher Data -

	Precision Required	Primary or Secondary	Sampling Rate
Elevation	$\pm\frac{1}{4}$ degree	P	N/A
Azimuth	$\pm\frac{1}{2}$ degree	P	N/A

b.- (U) Spacecraft Data - The flight phases will be defined as boost in coast and LEM separation, descent propulsion testing, LEM staging and ascent propulsion testing and reaction control propulsion testing. The nomenclature for the phases will be abbreviated as boost, descent tests, ascent tests and reaction control tests respectively.

B.- Trajectory and Associated Data Requirements

1.- Firing and Flight Data

b.-(U) Spacecraft Data -
Distance versus time data will be required for all phases of the test from lift off to ascent stage impact, and from separation to impact for those components which separate from the test vehicle during the test (i.e. booster, shroud, descent stage, etc.).

The trajectory and ground footprint information to be used for range planning to obtain distance versus time data are discussed in Section I.D.1 of this RFWAR, and tabulated below with the accuracy and sampling rate desired. The distances given are from the launch point and are not in a single plane. Reference to the ground footprint (figure 7) is required to fix the position of the vehicle.

(1) (C) Position Data

Phase	Distance (ft.10-3)	Time (Sec)	Precision Required*	Pri. or Sec.	Sampling Rate
Boost	0-22	0-103	+5 ft.	P	5/sec.
Descent Tests	22-231	103-670	±20 ft.	P	5/sec.
Ascent Tests	231-271	670-835	±20 ft.	P	5/sec.
RCS Tests	271-259	835-Impact	±20 ft.	P	5/sec.

(2) (C) Velocity Data

Phase	Distance (ft.10-3)	Time (Sec)	Precision Required*	Pri. or Sec.	Sampling Rate
Boost	0-22.	0-103	±10 ft/sec	P	5/sec.
Descent Test	22-231	103-670	±10 ft/sec	P	5/sec.
Ascent Test	231-271	670-835	±10 ft/sec	P	5/sec.
RCS Tests	271-259	835-Impact	±10 ft/sec	P	5/sec.

(3) (C) Acceleration Data

Phase	Distance (ft.10-3)	Time (Sec)	Precision Required*	Pri. or Sec.	Sampling Rate
Boost	0-22.	0-103	±0.015 g	P	5/sec.
Descent Test	22-231	103-670	±0.015 g	P	5/sec.
Ascent Test	231-271	670-835	±0.015 g	P	5/sec.
RCS Tests	271-259	835-Impact	±0.015 g	P	5/sec.

*Precisions are from previous L. J. flights pending discussions with WSMR

B.- Trajectory and Associated Data Requirements

1.- Firing and Flight Data

b.-(U) Spacecraft Data -

(4) (C) Attitude Date (Pitch, roll and yaw)

Phase	Distance (ft.10)	Time (Sec)	Precision Required*	Pri. or Sec.	Sampling Rate
Boost	0-22	0-103	±5°	P	5/sec.
Descent Test	N.R.				
Ascent Test	N.R.				
RCS Tests	N.R.				

All attitude data should be referenced to the coordinate system used for position and velocity.

(5) (C) Events - Specific events for which data are required are tabulated below.

Event	Distance	Time	Precision Required*	Data Required
First motion of boost	0	t+0	±0.1 sec.	Time
Ignition of 3 Algols	4000	t+39		Photographic recording of exhaust plume and vehicle attitude.
Shroud Separation	20000	t+95		Relative Position & Velocity of the 2 shroud halves in relation to the booster for 10 secs subsequent to separation.
LEM Separation	22000	t+97		Relative position & velocity of LEM in relation to booster for 15 secs subsequent to separation.
Recoverable Package Separation	271000	t+835		Relative position & Velocity of packages in

B.- Trajectory and Associated Data Requirements

1.- Firing and Flight Data -

(5) (C) Events -

Event	Distance	Time	Precision Required*	Data Required
				relation to LEM for 5 secs subsequent to separation.
Recoverable Package Impact			N/R	Photographic coverage of terminal descent and impact is desirable.
Descent Propulsion Failure				Real time position of LEM from range tracking to detect deviation from planned trajectory.
Component Impact				
Booster	135000	445		
Shroud	178000	1844		
LEM Descent	259000	1007		
LEM Ascent	268000	915		Impact Position.

(6) (U) Miss Distance - N/A

c.- (U) Target Data - N/A

d.- (U) Data Presentation Format - This information will be provided at a later date.

2.- Telemetry

a.- Number of transmitters to be used

1) (U) Little Joe II - unknown
2) (U) LEM - A maximum of five telemetry transmitters will be used in the LEM.

b.-(U) Type of Modulation of each Transmitter - The transmitters will be FM modulated.

B.- Trajectory and Associated Data Requirements

2.- Telemetry

c.-(U) Number of Data Channels for each transmitter which will be commutated and the functions transmitted on each channel.

The implementation of the LEM-1 measurements list is presently in progress. General planning is to FM modulate IRIG standard channels 2 through E with time division multiplexing (Commutation) on channels 14, 15 and E The commutations being considered are 90 x 10 and 90 x $1\frac{1}{4}$. The measurements for the test are listed in GAEC Report No. LED-360-9, Measurements List for LEM-1, dated 11-15-63.

d.-(U) Type of in-flight calibration - The requirement for in-flight calibration is presently being evaluated.

e.-(U) Accuracy and reliability required of ground equipment.

(1) (U) The required accuracy of the ground equipment for telemetry reception, tape recording, decommutation and display should be within the standards established in parts 6 and 7 of IRIG Document No. 106-60 (Revised June 1962).

(2) (U) The reliability should be 99.9 percent.

f.- Description of data display requirements.

(1) (U) During ground operations real time displays will be required during integrated systems tests and checkout.

(2) (C) During flight - A ground command can be sent to the LEM which will cause the vehicle to stage and will commence ascent propulsion tests if a failure is experienced in the descent propulsion system. The decision to transmit this command will be made using real time display of approximately twenty parameters in conjunction with real time position and tracking information provided by the range tracking network. Display of the twenty parameters will require real time de-commutation.

g.-(U) Tape and film size, speed required, and number of copies.

(1) (U) The telemetered data should be recorded on $\frac{1}{2}$ inch, 7 track, magnetic tape at a tape speed of 60 inches per second.

(2) (U) Descriptive information for the onboard tape and recoverable cameras will be provided at a later date.

B.- Trajectory and Associated Data Requirements

2.- Telemetry

h.-(U) Range equipment required for the preflight checkouts (Calibration and closed loop facilities). This information will be provided at a later date.

i.-(U) Describe Antenna System - This information will be provided at a later date.

j.-(U) Data Reduction requirements - This information will be provided at a later date.

3.- Tracking Aids

a.-(U) Describe space and weight available for airborne instrumentation. Redundant "c" band beacons will be installed in the ascent stage of the LEM to facilitate tracking with APS-16 radar. The requirements for other instrumentation should be coordinated with GAEC as weight increases will decrease the test time available.

b.-(U) Describe capability for installation of tracking aids and devices. It is anticipated that addition of paint patterns, flares and other devices of similar nature may be added without penalty to the test time.

4.- Timing

a.-(U) One, ten and 100PPS time code will be required at the vehicle assembly building, the blockhouse, the telemeter trailer, and the launch site.

b.-(U) The timing accuracy and format should be compatible with IRIG B & C time code systems (refer to IRIG Document 104-60, Time Format Standards).

5.- Photography (Technical, Historical and Documentary)

a.-(U) Motion Picture

(1) (U) Purpose - Motion picture coverage will be required for technical and documentary purposes.

(2) Type of Film

(a) (U) 16 mm Ektachrome Commercial Original, type 7255 film will be used. In those cases where adverse lighting exists or high frame rates are to be employed, Ektachrome ER, type 7257 (daylight), or Ektachrome ER, type 7258 (tungsten) may be used.

B.- Trajectory and Associated Data Requirements

5.- Photography (Technical, Historical and Documentary)

(2) Type of Film

(b) (U) In no instance may Ansco, Kodachrome or black and and white film be used.

(3) Outline of Subject Content - The photographic documentation effort will entail coverage of the following activities:

(a) Preflight Preparations

1) (U) Preparation and/or refurbishing of the launch site.

2) (U) Arrival of the LEM/Little Joe II shroud and adapter.

3) (U) Arrival of the LEM test article at Holloman AFB.

4) (U) Transport to and arrival of the LEM at the NASA Propulsion System Development Facility.

5) (U) Transport of the LEM to the Vehicle Assembly Building in area A.L.A.-3 of the WSMR.

6) (U) Integrated systems checkout in the VAB.

7) (U) Build up and preparation of the Little Joe II booster.

8) (U) Transfer of the LEM to the launch pad and installation on the booster

9) (U) Final checkout and countdown activity:

(U) in blockhouse
(U) on and around launch pad
(U) at tracking stations

(b) Flight Operations

1) (U) Launch

(c) Post-flight activity

1) (U) Recovery of data packages

2) (U) Arrival of personnel at impact area

3) (U) Post-flight inspection activity

(4)-(U) Complete Documentary

NASA/MSC must accumulate as complete and authentic a pictorial record of all Apollo program activities and development events as possible. It is anticipated that a complete motion picture will be made.

(5)-(U) Aerial Coverage

Airborne coverage of the flight will not be required. Any requirement for coverage of prelaunch operations will be furnished by the NASA.

(6)-(U) Specifications

(a) (U) Original film shall not be cut except to eliminate waste film caused by camera failure or faulty photographic techniques (gross over or under exposure, over or under development) which result in qualitatively unsatisfactory film.

(b) (U) All original camera film footage shall be slated whenever possible. Slate information shall include:

NASA
LEM/Little Joe II
Contract No. 9-1100
Security Classification
Date
Scene and Take number

Three copies of caption information describing the action in each scene shall be delivered with all original film footage to the NASA/MSC.

(c) (U) All individual reels of classified film shall have head and tail security classification leaders.

b.- Still Photography

(1) (U) Purpose - Still coverage is intended for documentation.

(2) Type of film

(a) (U) As a general rule still photography shall be accomplished on 4 x 5 inch black and white film. 4 x 5 negative or reversible color film should be used in those instances where it is deemed essential to record and present the subject matter distinctly and accurately and for significant highlight events such as launch.

(b) (U) In certain cases such as actual launch sequential cameras with different negative dimensions and/or utilizing roll film may be used.

5.- (U) Photography (Technical, Historical, and Documentary)

b.- Still Photography

(3) (U) Number of Prints - All original negatives will be turned over to GAEC if obtained by on-site photographic unit camermen. These negatives are the property of NASA/MSC; Grumman is charged with the responsibility of insuring their delivery to NASA/MSC at the earliest possible date after exposure. In addition to a contact print, four $8\frac{1}{2}$ x 11 inch prints will accompany each negative.

(4) (U) Aerial Coverage - Airborne coverage of the flight will not be required. Any requirement for coverage of prelaunch operations will be furnished by NASA.

(5) (U) Specifications -

(a) The following data shall be lettered in ink on the clear margin of each original negative or color transparency on the acetate side starting from the left; negative number, data, "LEM/Little Joe", Contract No. 9-1100, and classification.

1) (U) The negative number. This shall be WSMR's own numbering system for reference purposes.

2) (U) The date shall consist of numerals for the date of the month, followed by the abbreviated name of the month, followed by the last two digits of the calendar year.

(b)(U) Each negative or color equivalent shall be placed in a separate negative preserver with a contact print attached.

(c) (U) The negative identification data shall be reproduced on all prints made. This may be accomplished by any means which will insure a permanent record, such as photographic reproduction, typing, rubber stamp, etc.

c.- Photographic Instrumentation

(U)Two Milliken DBM-3A cameras will be mounted on opposite sides of the ascent stage (figure 8). The optical axis of the camera will be parallel to the LEM thrust axis and a 110-160° wide angle lens will face the descent stage. The housing for the camera will be standard Cooke Research Labs recoverable pod modified for LEM/Little Joe requirements (i.e. land recovery).

d.- Coordination

(U)All photo requirements will be coordinated with the NASA/WSMR by a Grumman photo-coordinator.

It is requested that access to those areas of WSMR involved in the activities covered by this RFWAR be granted to this coordinator.

6.- Communications

a.- Narrative Outline

(1) (U) Administrative telephones - The number of phones required in the vehicle assembly building, blockhouse, launch pad and telemetering vans will be supplied at a later date. It is also anticipated that phones will be required in designated explosive areas.

(2) (U) Intercom networks - The intercom network required for project coordination, pre-launch checkout, range countdown, etc. will be supplied at a later date. At that time the location, cord lengths, need for remote units and other details will be described.

(3) (U) Ground-air Communications - Ground-air communications will consist of an uplink command capability using the range supplied DRW-11 equipment and a downlink capability for telemetering PAM/FM/FM in the 225-260 mcs range.

(4) (U) Point-to-Point Communications - The requirement for local battery telephones to provide communications between closely grouped activities will be submitted at a later date.

(5) (U) Radio Command Guidance

(a) (U) Little Joe II - This information will be provided by NASA.

(b) (U) LEM - There will be no ground guidance of the LEM. A DRW-11 RF link, provided by WSMR, will be used to transmit the following commands should a failure or malfunction requiring these commands occur.

1) (C) Advance in-flight programmer to ascent propulsion tests. (in event of descent propulsion failure)

2) (U) Disperse LEM hypergolic fuel (for range safety).

(6) Data Transmission

(a) (U) Little Joe II - This information will be provided by NASA.

(b) (U) LEM - Five PAM/FM/FM transmitters in the 225-260 mcs range will be used for telemetry data. Voltage levels, type of equipment, permissible degradation of data in T/M link etc., will be provided at a later date.

(7) (U) Control Circuits - Information on hardline control circuit required, if any, will be provided at a later date.

(8) (U) Voice Radio - N/A

(9) (U) Public Address Facilities - Public address facilities will be required in the vehicle assembly building and the launch site for project coordination (i.e. "clear the pad", etc)

Public address requirements for the VIP and press observers will be supplied by NASA.

b.- (U) Additional Information

A remote station on the TWX line from Grumman Bethpage to the Grumman facility at the NASA/PSDF will be required. This station shall be located in the vehicle assembly building in area A.L.A - 3 and shall be capable of direct transmission to the PSDF and/or Grumman Bethpage.

7.- Frequency Authorization

a.- (U) Authorization - NASA will request frequency authorization. (refer to Paragraph 7C below)

b.- (C) Project Frequencies

(1) Instrumentation

(a) Nomenclature - Telemetry
(b) Frequency - 5 frequencies in the 225-260 mcs range
(c) Purpose - Telemetry
(d) Emission - unknown
(e) Power - 5 watts
(f) Modulation - FM
(g) Location - 4 in the LEM ascent stage, 1 in the LEM descent stage
(h) Antenna gain - none
(i) Guard Band - N/A
(j) Simultaneous Frequency - All five
(k) Radiation Time - from prelaunch countdown to impact.

(2) (U) Command - The DRW-11 RF equipment supplied by the WSMR will be used for this function.

c.- (U) Request for frequency authorization - NASA will submit the requests for frequency authorization in accordance with the WSMR directive "Radio and Radar Frequencies Allocation, Authorization, and Utilization".

d.- (U) Frequency Monitoring - This information will be furnished at a later date.

8.- Radar

a.- (U) Requirements - It is planned to use the FPS-16 radar and "C" band beacons for range safety tracking and descent propulsion failure detection. The latter will be accomplished through real time position plotting in conjunction with real time instrumentation readouts from the telemetry system. PRF or pulse modulation control will be discussed with the WSMR later.

b.- (U) Project Radar Checkouts - The LEM test vehicle will not have radar aboard.

9.- Television

a.- (U) Closed circuit television will be required at the launch site to monitor the test vehicle during final countdown and lift off. These cameras in appropriate protective housings will be located 120° apart around a 200 foot radius circle whose center is the launch pad. They will be equipped with zoom lenses and pan and tilt mounts, all remotely controlled from the blockhouse.

Four viewing screens will be required in the blockhouse for continuous monitoring.

10.- Geodetics

Survey - N/R

11.- Recovery

a.- Number, Location, Safety and Handling Requirements

(1) (U) Little Joe - These requirements will be provided by NASA.

(2) (U) LEM Shroud - The LEM shroud will not require recovery under normal circumstances. However, an inspection of the shroud will be conducted at the impact site.

(3) (U) LEM - The desireability of recovering the LEM ascent and descent stages will be dependent on test results. It is anticipated that re-entry heat and impact will negate obtaining useable data, however, should a failure occur inspection of salvageable components will be desireable. The decision to recover or to bury the stages on the range will be made subsequent to the test and inspection of the impact area.

(4) (U) Recoverable Data Packages - Three recoverable data packages will be ejected during the flight. Two of the packages will contain cameras and the third will contain a tape recorder. Those packages containing cameras shall be transported with care directly to a dark room. Removal of the camera will be accomplished in the dark to prevent exposure of the film should the pod be damaged on impact.

b.- Security Classification - Security classification of the items which might be recovered is as follows:

(1) (U) Little Joe - Unknown
(2) (U) LEM Shround - Unclassified
(3) (U) LEM Ascent State - Unclassified due to reentry and impact damage
(4) (U) LEM Descent Stage - Unclassified due to reentry and impact damage
(5) (U) Recoverable Data Packages - Confidential

c.- (U) Disposition - All recovered items will be delivered to the Preparation building in the NASA/PSDF.

d.- (U) Time Limits - Inspection at the impact site shall be made within 12 hours. Recovery priorities, if necessary, will be established

11.- Recovery - continued

subsequent to the impact site inspections and the recovery should be completed within 48 hours.

e.- (U) Project Personnel - A minimum of one NASA/MSC and one Grumman Aircraft Engineering Corporation representative will accompnay and assist the range recovery team.

12.- Meteorological

a.- (C) Weather Causing Cancellation - It is expected that the launch vehicle will have restrictions on the launch wind conditions. Information on the magnitudes, directions, gusts, shears, and turbulence levels which will cause cancellation of the test will be furnished later. Other weather conditions which will cause cancellation are blowing sand, precipitation, cloud coverage or other phenomena which will hinder or preclude photographic coverage to an altitude of 40,000 feet.

b.- (U) Air Structure Data Required - The pressure and temperature lapse rates with altitude will be required for the boost phase of the test. Additional and detailed requirements will be furnished at a later date.

c.- (U) Wind Data Requirements - Surface winds will be required during the prelaunch checkout, final countdown and launch. Winds aloft will be required for the final countdown and the boosted portion of the flight. The altitude increments, ranges and precisions required will be furnished at a later date.

d.- Forecasts Required -

(1) (U) Surface wind forecasts will be required when the booster assembly begins on the launch pad. An immediate alert will be required on a 7-day per week, 24-hour basis any time winds are predicted to exceed 30 knots. These reports will be continued for each incremental rise of 5 mph (for vehicle tie-down reasons).

(2) (U) Regional and local forecasts for the following 24, 48 and 72 hour periods will be required beginning two months prior to launch (to plan and coordinate launch pad activity).

(3) (U) Upper wind forecasts will be required beginning one week prior to the launch date.

e.- (U) Questionnaire for Range Users

(1) (U) Upper Air Data

12.- Meteorological - (1) Upper Air Data - continued

	Time & Freq.	Place of Test	Precision Desired	Presentation
Wind	During count-down & flight	Launch Site	±1.0 knots	vs. true alt. above msl (ft)
Temperature	During count-down & flight	Launch Site	±1.0°C	"
Humidity	REQUIREMENT UNKNOWN			
Pressure	During count-down & flight	Launch Site	±0.2 mb	"
Density	During count-down & flightq	Launch Site	±2 gm/m^3	"
Other	N/A			

Remarks: The frequency of measurement will be furnished later.

(2) (U) Surface Data

	Time & Freq.	Place of Test	Precision Desired	Presentation
Wind	During count-down & launch	Launch Site	±1.0 knots	vs. time
Temperature	During count-down & launch	Launch Site	±1.0°C	vs. time
Pressure Altitude	During count-down & launch	Launch Site	±0.2 mb	vs. time
Clouds (Cover Height)	During count-down & launch	Launch Site	±5.0% & 200 ft.	tabulated
Precipitation	N/A			
Visibility	During count-down & launch	Launch Site	±0.5 mi	tabulated
Humidity	REQUIREMENT UNKNOWN			
Refractive Index	During count-down & launch	Launch Site	±15.0%	vs. time
Density	During count-down & launch	Launch Site	±2 gm/m^3	vs. time

12.- Meteorological - (2) Surface Data - continued

	Time & Freq.	Place of Test	Precision Desired	Presentation
Other	N/A			

Remarks: The frequency of measurement will be furnished later.

(3) (U) Forecasts

	Forecast Period In Hours	Surface	Aloft	Critical Layer
Wind	72, 48, 24, 12	X	X	not defined
Wind Sheer	72, 48, 24, 12	X	X	"
Turbulence	72, 48, 24, 12	Gusts	X	"
Temperature	72, 48, 24, 12	X	X	N/A
Pressure	N/R			
Pressure Altitude	N/R			
Cloud (Cover & Height)	72, 48, 24	X	X	not defined
Precipitation	78, 48, 24	X	X	N/A
Visibility	78, 48, 24	X	X	not defined
Humidity	78, 48, 24	X	X	not defined
Refractive Index	N/R			
Density	N/R			
Other	N/A			

Remarks:

13.- Air Support Requirements

a.- (U) Manned and drone aircraft or targets - The need for aerial photographic coverage of the launch pad and the surrounding area during prelaunch operations will be established by NASA. This RFWAR presumes there is no such requirement.

b.- (U) Transportation - The need for air transportation of project personnel and/or data will be furnished by NASA.

13.- Air Support Requirements - continued

c.- (U) Pilot Briefing - Pilots, if required, must be thoroughly briefed within two weeks of the first flight.

d.- (U) Supersonic Missions - N/A

14.- Reports

a.- (U) Type of Presentation - This information will be furnished at a later date.

b.- (U) Data Processing Requirements - This information will be furnished at a later date.

c.- (U) Maximum Time Lag - All data and data reports shall be delivered to the office of the Manager, NASA/MSC/WSMR Operations, within time intervals to be established later.

SECTION III - Laboratory and Related Tests

A.- (U) General Test Information - The laboratory tests required will be in the category of Technical Support for the flight. (refer to paragraphs below)

B.- (U) Description of Test - N/A

C.- (U) Technical Support Requirements

1.- (U) Instrument Standards Calibration - Instrument and electronic test equipment calibration services may be required from the WSMR. The detailed requirements will be dependent on the capabilities of the NASA PSDF. This information should be coordinated with NASA-WSMR Operations.

2.- (U) Launcher Behavior Instrumentation - NASA will indicate whether WSMR will be required to provide engineering data for launcher design and/or evaluation.

3.- (U) Propellant Analysis Requirements - The decision to perform the propellant analysis on the WSMR or to utilize the NASA/PSDF will be made by NASA/MCS.

4.- (U) Fluid Contamination Analysis - As with propellants, NASA/MSC will provide these requirements.

5.- (U) Metallurgical or Radiological Services - Previous Little Joe II flights will have required services for inspection of the critical areas of the launcher. It is expected that such a requirement will still exist. NASA/MSC will provide more definitive information.

6.- Preflight Motor Temperature Conditioning Services

a.- Little Joe II

1) (U) Motor temperature (grain) monitoring and monitoring of inlet and outlet air conditioning temperatures will be required on the launch pad.

2) (U) Monitoring and maintaining of temperatures within storage igloos will be required. Recordings of igloo temperatures will be required.

3) (U) Environmental controlled storage for batteries will be a possible requirement.

7.- (U) Environmental Conditioning Simulation - N/R

8.- (U) Airborne Missile Instrumentation - Current planning does not require WSMR to provide for checkout of airborne telemeters or recorders. WSMR will provide the hardware for checkout of the DRW-11 equipment.

9.- (U) Instrument Library Services - There will be no planned requirement for short term loans of test and measuring instruments.

D.- (U) Special Safety Considerations -

The handling of the toxic and hypergolic propellants will require safety precautions if the NASA/MSC requests the WSMR to perform the propellant analysis.

E.- (U) Test Plans and Directives -

The test plans and procedures will be provided by Grumman Aircraft Engineering Corporation with approval by NASA.

F.- (U) Information References -

Applicable references for further information on the tests of Section III will be furnished later.

SECTION IV - SPECIAL FACILITIES REQUIRED

A.- Additional personnel to be stationed at WSMR for this project only.

1.- (U) Civilian

	Number	Date of Arrival	Departure
a.- Federal	will be supplied by the NASA		
b.- Contractor (GAEC)	90 (2 shift total)	Jan. '66	Tentatively Nov. '66
GAEC vendor	will be furnished later		
c.- Other	will be furnished by the NASA		

2.- (U) Military - N/A

B.- Personnel Requiring Additional Office Space

1.- (U) Contractor Personnel

	Number	Arrival
GAEC	40 (2 shift total)	Tentatively Jan. '66
GAEC vendor	Will be furnished by NASA	
Other	Will be furnished by NASA	

2.- (U) Government Civilian Personnel - will be furnished by the NASA.

3.- Location of Space

a.- (U) GAEC - Major engineering and administrative support for the tests will be maintained at the NASA/PSDF. The personnel to be stationed on the range will be those directly required for prelaunch checkout of the vehicle. The office space will, therefore, be required in A.L.A.-3.

b.- (U) Other - NASA will furnish location information for government and other contractor employees.

4.- (U) Military Service to Provide this Space - N/A

C.- (U) Number of Personnel Requiring Additional Mess Facilities and Housing -

Any or all of the above listed personnel may wish to take advantage of available WSMR cafeteria and/or messing facilities. At the launch site, A.L.A. -3, which is a remote location, there will be a requirement for messing and/or cafeteria facilities for both noon and evening meals during launch operations.

D.- Inert Storage or Assembly Space

1.- Description of Supplies to be Stored

a.- (U) Little Joe II - This information will be furnished by the NASA.

b.- LEM

(1) Storage

(a) (U) Long Term - Present planning is to use the NASA/PSDF for long term storage facilities. The exception to this will be the LEM Little Joe II shroud which will arrive and be stored at the WSMR until it is required at the launch site.

(b) (U) Ready Issue - GSE etc. - The ready issue, print, instrumentation, etc., storage required after the LEM arrives in the vehicle assembly building will use those areas previously used by NAA (i.e Rooms 104 through 112 of VAB). GSE closed storage will be done in the assembly area, while GSE open storage will require 800 square feet in the area of the VAB.

(2) Assembly Space

(a) (U) Environment - The assembly area used for LEM checkout shall be designed to prevent dust accumulation, be pressurized above ambient, and have an air filtering system.

(b) (U) Area Requirements - 4800 square feet of assembly area will be required. This area will contain the 24 ft x 28 ft LEM work stand, a weight and balance fixture, a receiving, unloading and inspection area, space requirements for the checkout GSE, and a GSE storage area.

E.- Hazardous Storage or Assembly Space

1.- Types of solid explosives and solid propellants required on hand at one time.

a.- (U) Little Joe II - Algol ID solid propellant motors and destruct charges for the motor case will be on hand for the Little Joe.

b.- (U) LEM - The LEM system will contain mild detonating fuse, linear shaped charges, detonators, initiators and safe-arm mechanisms.

2.- Quantity of Solid Explosives and Propellant

a.- (U) Little Joe II - This information will be provided by the NASA/MSC.

b.- (U) LEM - The following quantities are the maximums which are anticipated for one LEM system, shroud and adapter:

Mild detonating fuse (MDF)	50 ft.
Linear shaped charge	500 ft.
Detonators	20 ft.
Initiators	100
Safe arm mechanisms	6

3.- Types of Liquid Propellants

a.- (U) Little Joe II - The Little Joe II model 12-51 has a hydrogen peroxide reaction control system for attitude control.

b.- (U) LEM - The LEM system propellants are a 50/50 combination of hydrazine (N_2H_4) and unsymmetrical dimethylhydrazine (UDMH) and nitrogen tetroxide (N_2O_4).

4.- Quantity of Liquid Propellants

a.- (U) Little Joe II - This information will be furnished by NASA/MSC.

b.- (U) LEM - The LEM propellants (≈20000#) will be brought to the launch site in trailers from the NASA/PSDF.

5.- Proposed Methods of Shipment of Hazardous Materials and Service Requested to Provide Storage.

a.- (U) Shipment of the materials will conform to ICC standards for transporation. On-post transportation of explosive items will be the responsibility of the WSMR.

6.- Rates of Delivery for above Items as Applicable - This information will be furnished at a later date.

F.- Utilities

1.- Office Area

a.- (U) GAEC - The following utilities will be required.

Telephones
Intercom
120 volt, 60 cycle, 100 amp AC
Drinking water
Standard Sanitary provisions

b.- (U) Other - This information will be furnished by the NASA.

2.- (U) Shop Area

a.- GAEC- the assembly area will require: 120/208-30-4 wire 200 amp
277/480-30-4 wire 100 amp
28V DC 50 amp
GN_2 - "K" Bottle Cascade
GHe - "K" Bottle Cascade
Shop Air - 100 psig 25 CFM
Lighting Level - 100 ft candle
Telephones
Drinking water
Standard Sanitary Provisions

F.- Utilities

b.- (U) Other - This information will be furnished by NASA/MSC

G.- Major Items

1.- (U) Number of vehicles by type to be furnished and maintained by WSMR.

Vehicles for passenger and over-the-road cargo transportation will be provided by NASA/MSC/WSMR Operations (refer to paragraph IV G 3 below).

2.- (U) Number of vehicles by type, the user will bring to WSMR that require Army support. - This information will be furnished by NASA/MSC/WSMR Operations.

3.- (U) Quantity and Description of Material Handling Equipment Required to be Furnished by WSMR - Handling equipment will be provided by NASA/MSC/WSMR Operations. A preliminary listing of the type which GAEC will require is given below:

Tractor Truck (fifth wheel & pintle hook)
Standard Flat bed semi trailer (low bed)
Semi-trailer (van)
Pick up ($\frac{1}{2}$ - 3/4 ton)
Tractor, wheeled, tow type (4000# pull)
Carry all (passenger)
Fork lift truck (15000# 72" forks)

4.- (U) Type of administrative Army aircraft and flying hours per month required to be furnished by WSMR. - This information will be furnished by NASA/MSC.

5.- (U) Number of GFE aircraft, by type, the user will bring to WSMR that required Army support. - This information will be furnished by NASA/MSC/WSMR Operations.

6.- (U) Number, by type, of other major pieces of equipment required to be furnished and maintained by WSMR. - The service tower, blockhouse and launch facilities in Army Launch Area 3 will be required. These facilities will require installation of the safety facilities needed for handling the toxic and hypergolic propellants (i.e. sniffers, alarms, showers, eye washes, etc.). The requirements for generators hoists, and etc., will be furnished later.

7.- (U) Number, by type, of other major pieces of equipment the user will bring to WSMR that require Army support. - This information will be provided by NASA/MSC/WSMR operations.

8.- (U) WSMR Services in support of major items (i.e. loading or unloading of railhead, etc.) - This information will be provided by NASA/MSC/WSMR Operations.

9.- (U) What of the above are specified as GFE in the contract?
The equipment is expected to be designated as GFE.

H.- Secondary Items

1.- (U) Office Area - Type of Equipment

	GAEC	Other
Desks, standard	30	
Chairs, standard	30	
Desks, secretary	2	
Chairs, secretary	2	
Drafting table	1	
Drafting Machine	1	
File Cabinets, 5 drawer	5	
Calculators, Frieden or equiv.	2	
Adding Machine, paper tape	1	
Typewriters, IBM electric	2	
Storage Cabinets (2 door 6 x 3)	2	
Hat/Coat racks	as required	
16 mm movie projector (stop reverse	1	
Film projector, slide $8\frac{1}{2}$ x 11	1	
Screen, film projector 4 x 6	1	
Blackboard 4 x 8	2	
Office Safe	1	
Ditto Machine $8\frac{1}{2}$ x 11	1	
Ozalid Machine $8\frac{1}{2}$ x 11	1	
Verifax machine $8\frac{1}{2}$ x 11	1	
Tables for repro equip.	1	
Conference table(6 person capacity	2	
Conference chairs	12	
Folding chairs	12	
Desk lamps	6	
Light, table tracing	1	

I.- (U) Security Requirements

Security will be required for the period of December 1965 to December 1966, based on present scheduling.

1.- (U) Will classified material be stored in office buildings other than in approved type safes and vaults? No.

2.- (U) In other buildings? Yes, the LEM system is confidential.

3.- (U) Will classified material be stored in approved type safes and vaults

a.- (U) In office buildings? Yes

b.- (U) In other buildings? Yes

4.- (U) Location and type of buildings in which classified material will be stored. - This information will be furnished later.

5.- (U) Building outside of security areas - When classified material is maintained in buildings or areas which are located outside of present security areas at Post Area, AFMDC and NOMTF, such material will constitute a security interest so located so that uncontrolled movement within the area or building would permit access to such security interest, but within which area such access may be prevented by escort and other restrictions and controls.

6.- (U) Recovery of classified components - Recovery of the data packages is desired within 2 hours of the test.

7.- (U) Security Guards - WSMR security guards will be required from December 1965 through December 1966.

8.- (U) Security classification of recovered packages - The recoverable data packages are classified "confidential".

J.- (U) Other

No other requirements at the present time.

SECTION V - OTHER WSMR SERVICES

1.- (U) Machine shops, carpenter shops, welding facilities and other similar activity support will be required on a limited basis.

2.- (U) Fire protection as required for normal safe operations in the hazardous and launch areas may be required.

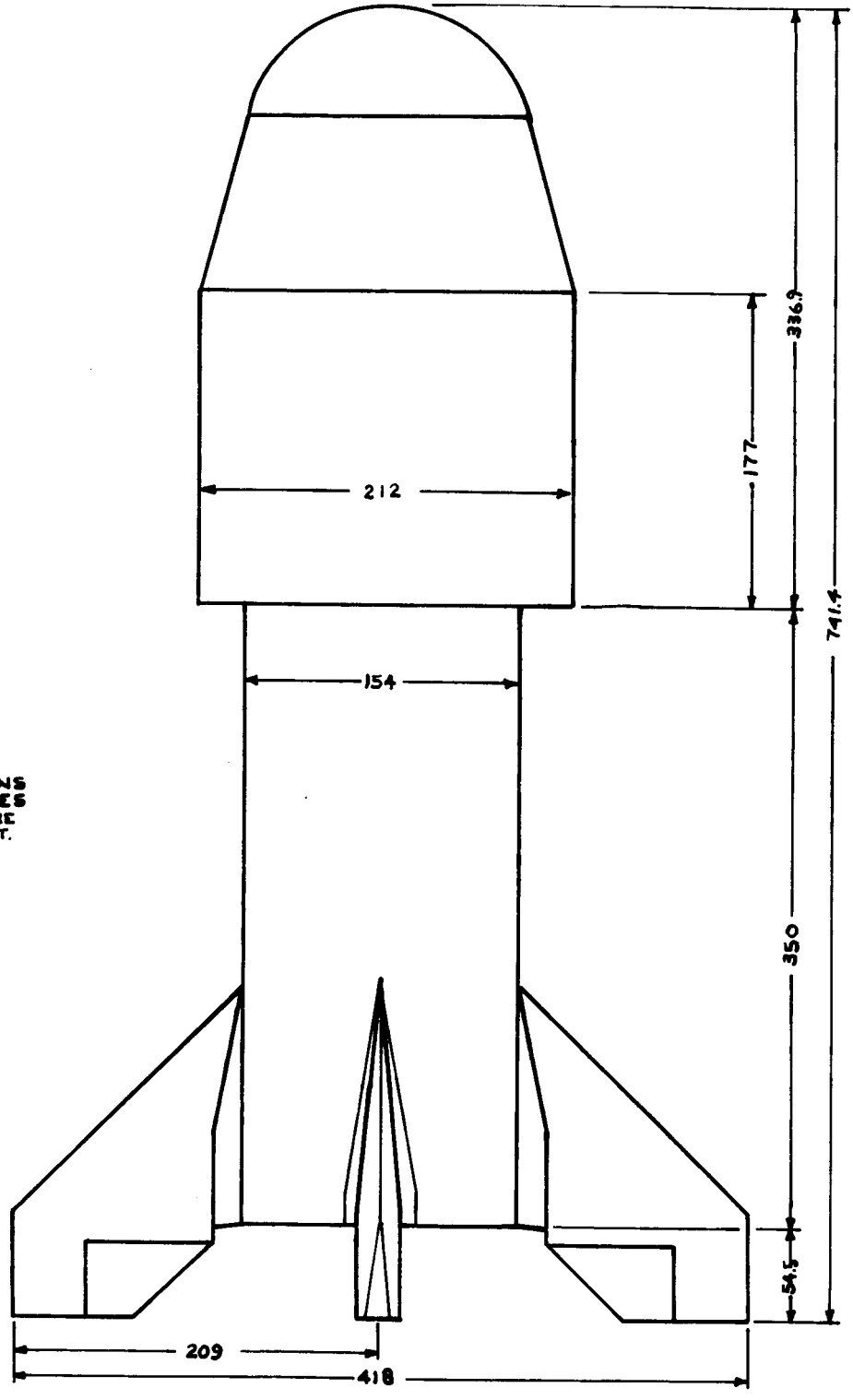
3.- (U) Medical facilities for emergency needs and normal safe operations in the hazardous and launch areas will be required.

4.- (U) WSMR operated buses or other personnel carriers may be required in the instance of large group orientation tours, etc.

5.- (U) Post transportation motor vehicle training courses will be required as an aid in qualification of NASA and/or contractor personnel for U.S. Government driving licenses.

6.- (U) Janitorial services are required for all buildings and work areas being provided to the NASA.

LITTLE JOE II/LEM
LAUNCH CONFIGURATION
SIDE VIEW

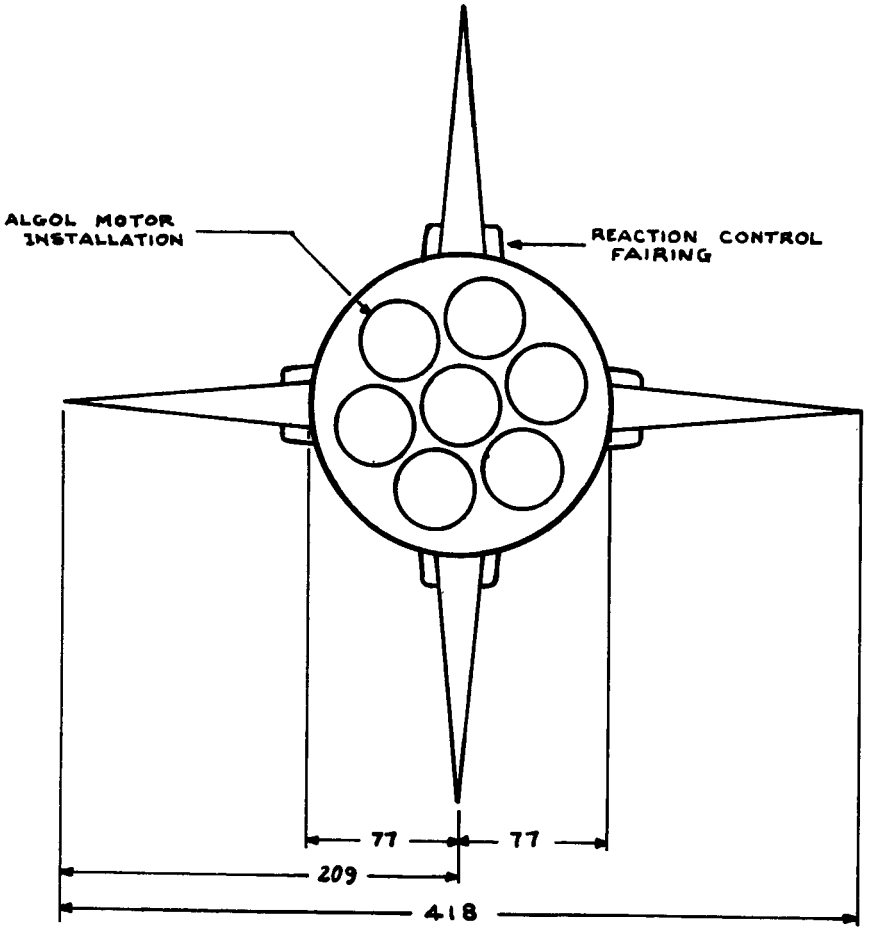


NOTES:

1.- ALL DIMENSIONS GIVEN IN INCHES
2.- FINS SHOWN ARE EACH 100 SQ.FT.

Figure 1a

LITTLE JOE II / LEM
LAUNCH CONFIGURATION
TAIL VIEW



NOTE

1- ALL DIMENSIONS GIVEN IN INCHES

Figure 1b

LEM
GENERAL ARRANGEMENT

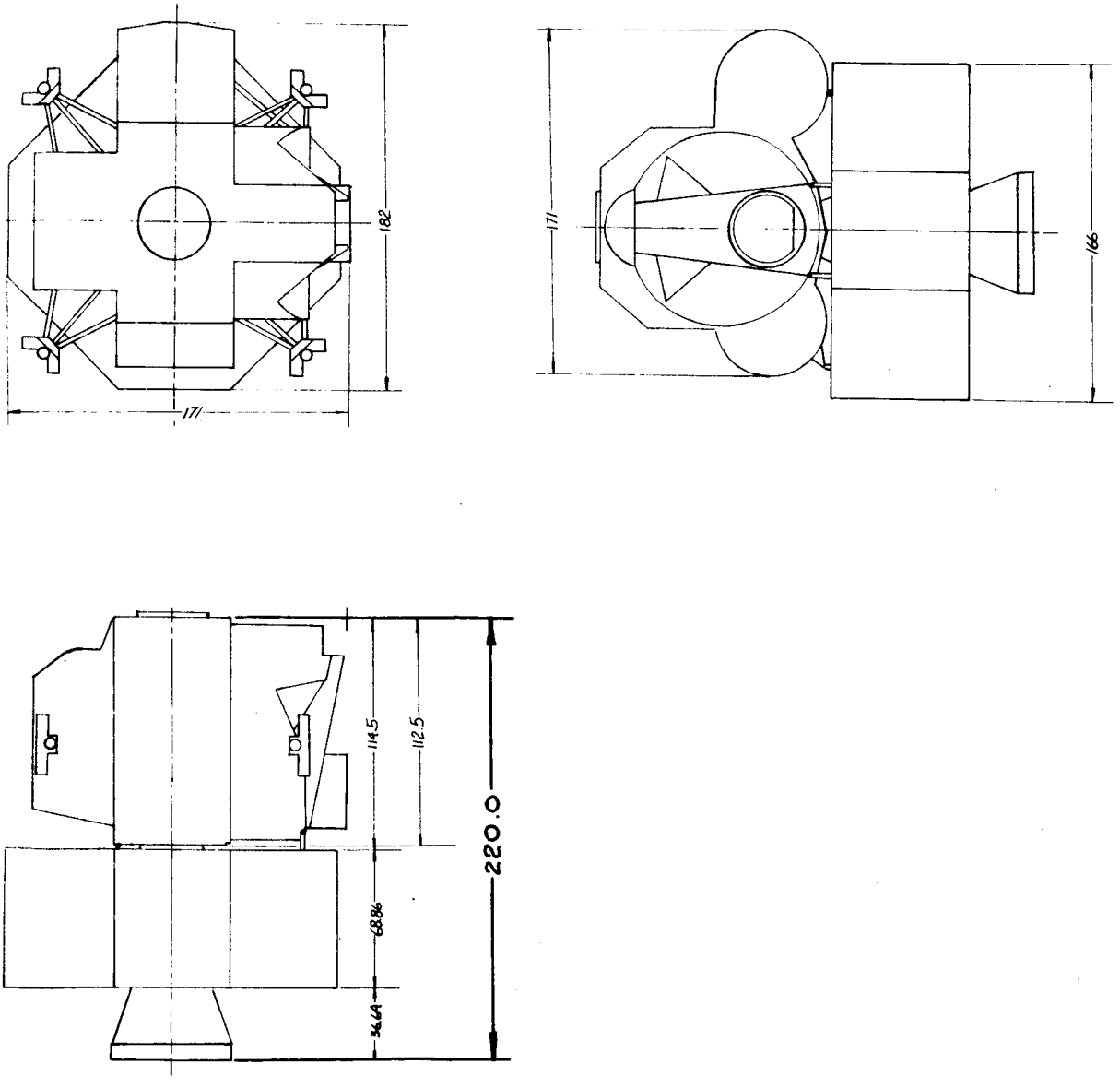


Figure 1c

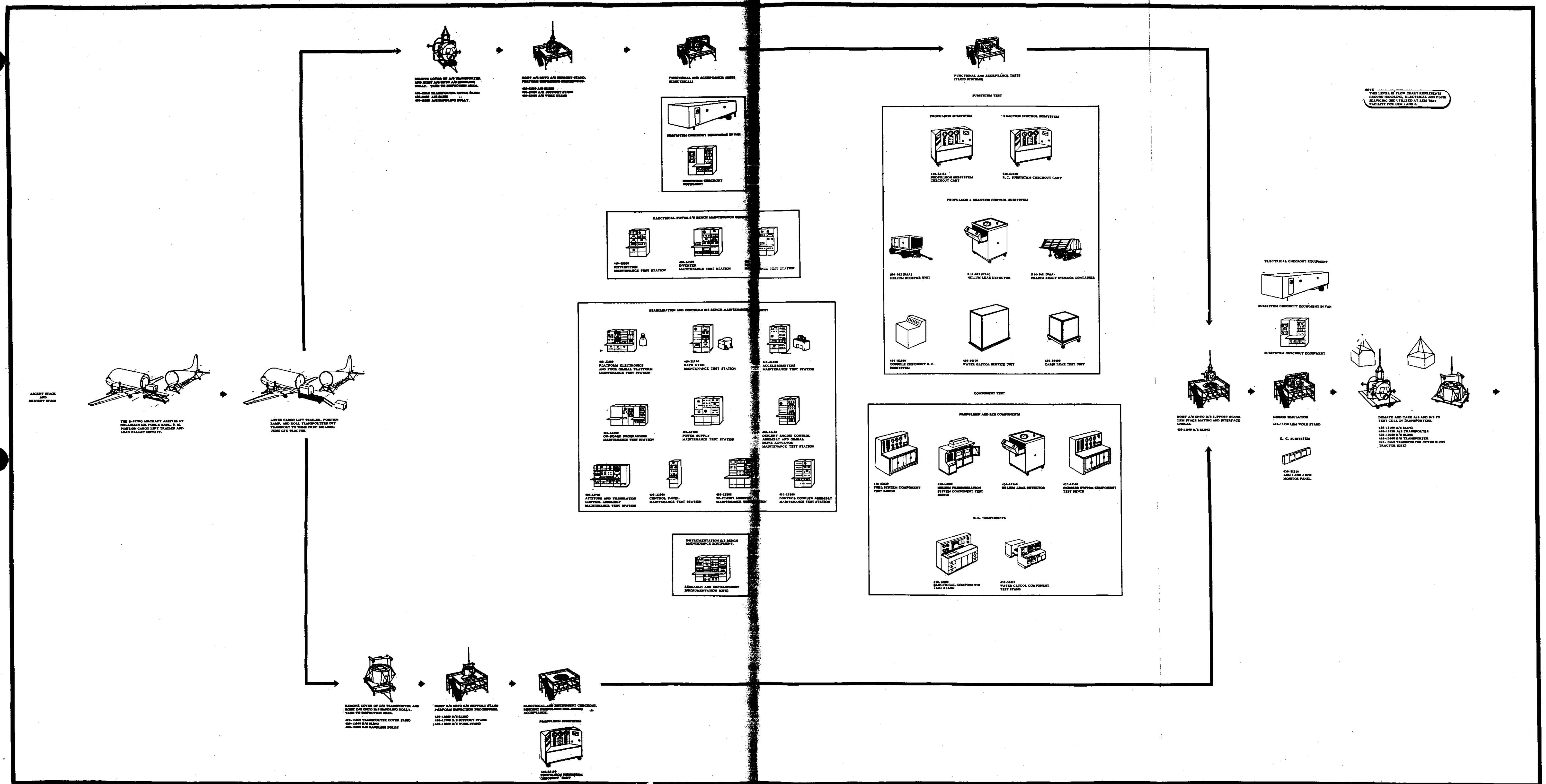


Figure 2a
Report LPL-611-2
Date 12/15/63

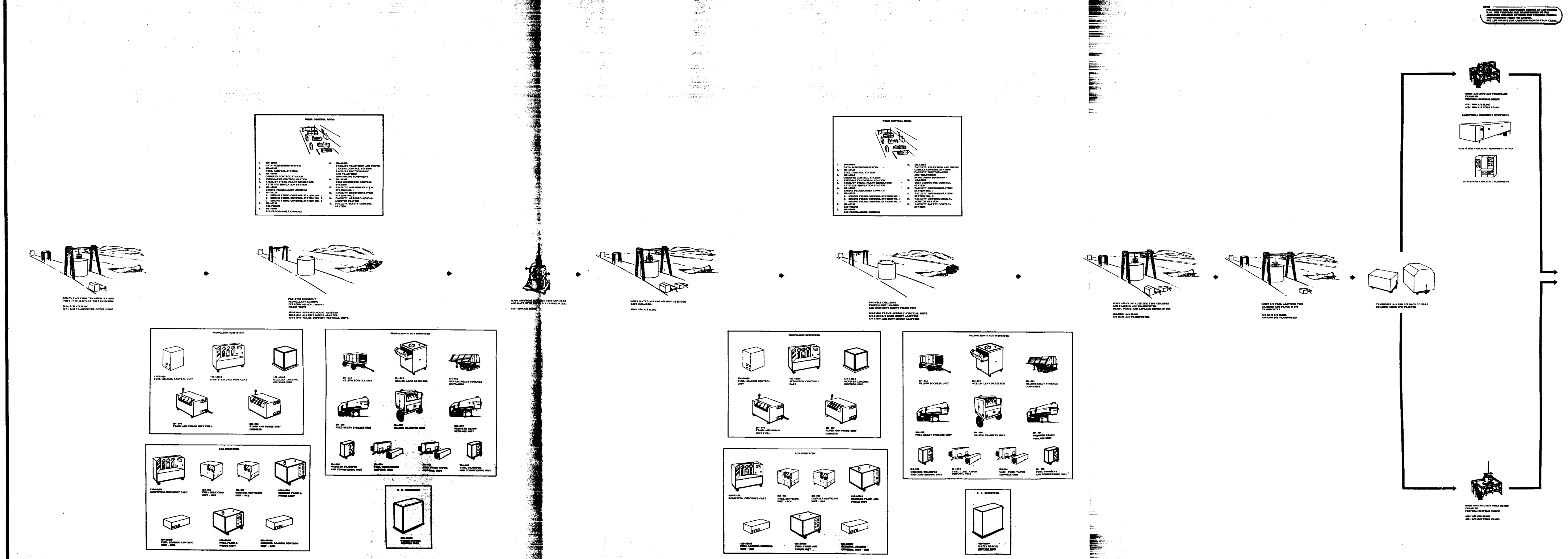


Figure 2b
Report LPL-611-2
Date 12-15-63

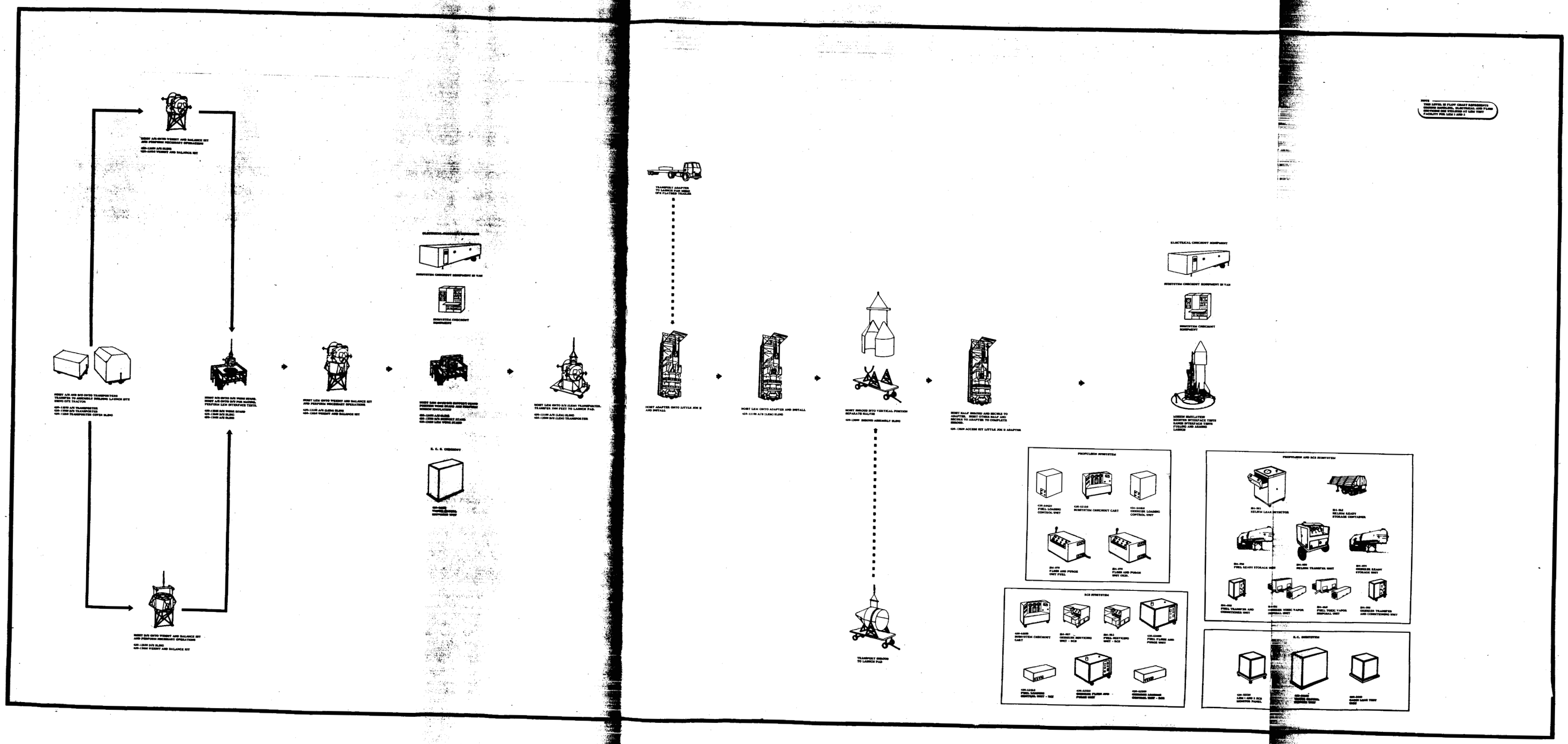


Figure 2c
Report LPL-611-2
Date 12-15-63

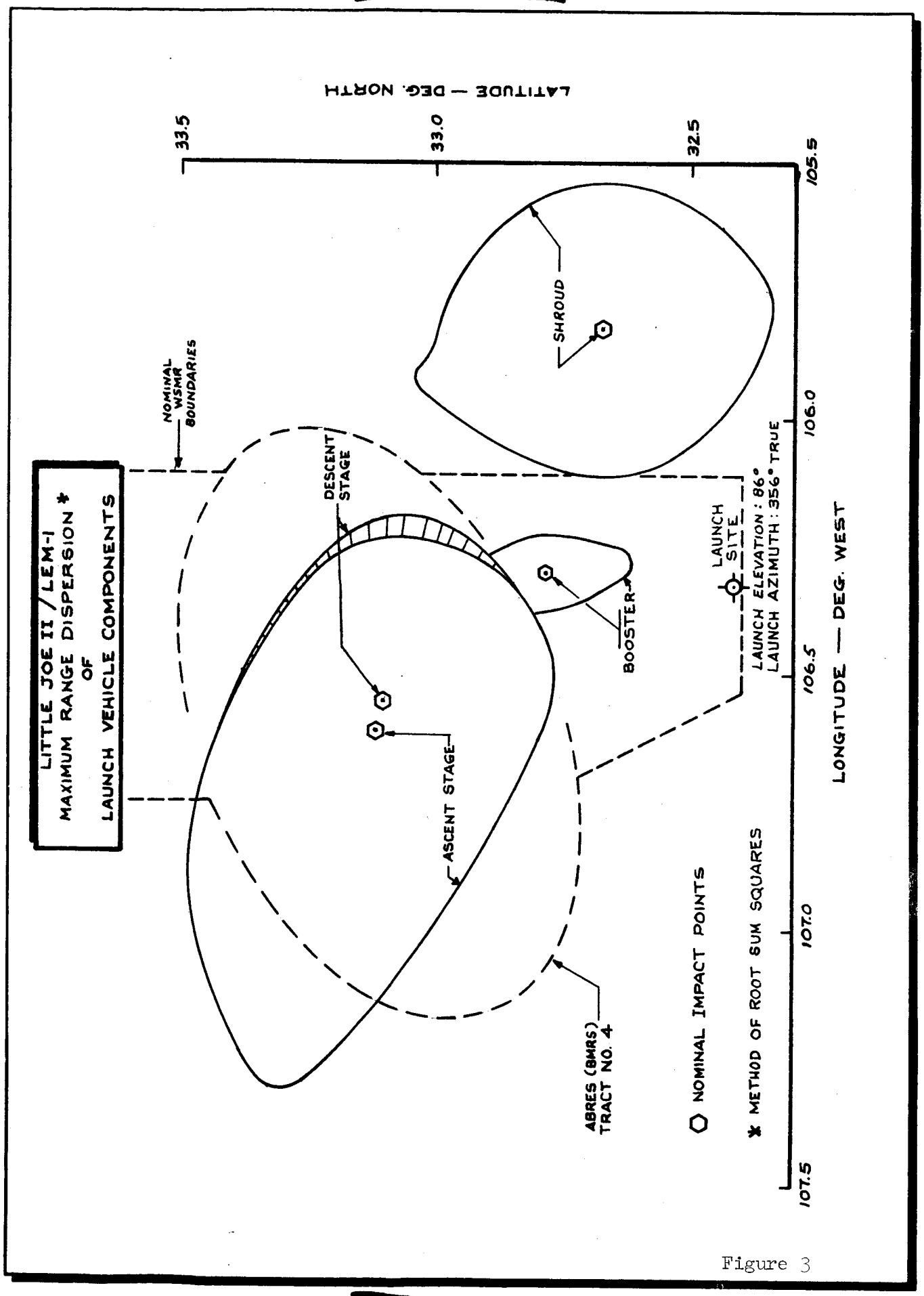

LITTLE JOE II / LEM-1
MAXIMUM RANGE DISPERSION *
OF
LAUNCH VEHICLE COMPONENTS
NOMINAL WSMR BOUNDARIES
DESCENT STAGE
ASCENT STAGE
SHROUD
BOOSTER
LAUNCH SITE
LAUNCH ELEVATION: 86°
LAUNCH AZIMUTH: 356° TRUE
ABRES (BMRS) TRACT NO. 4
NOMINAL IMPACT POINTS
* METHOD OF ROOT SUM SQUARES
LATITUDE — DEG. NORTH
33.5
33.0
32.5
LONGITUDE — DEG. WEST
105.5
106.0
106.5
107.0
107.5

Figure 3

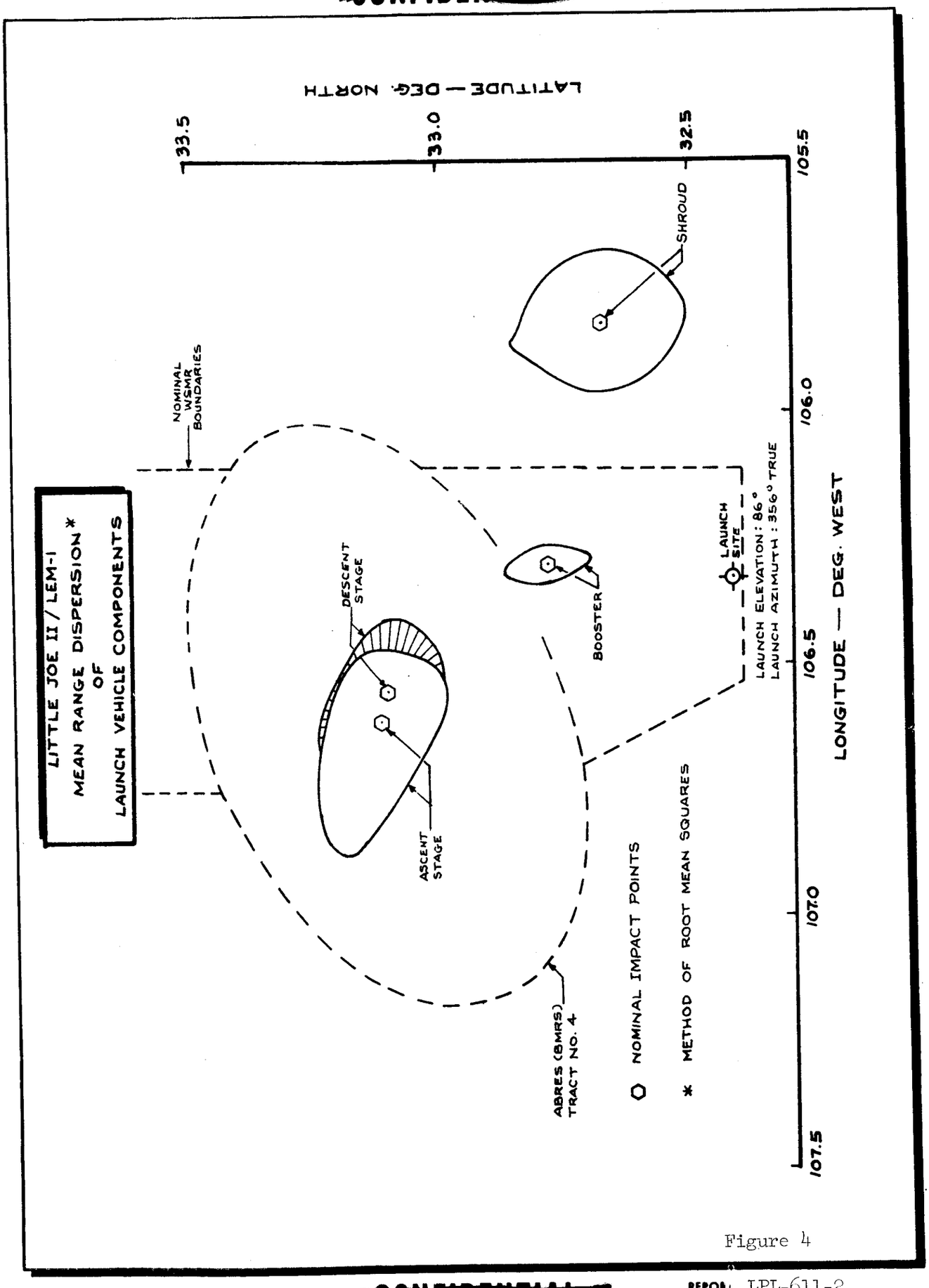

LITTLE JOE II / LEM-1
MEAN RANGE DISPERSION *
OF
LAUNCH VEHICLE COMPONENTS
LATITUDE — DEG. NORTH
33.5
33.0
32.5
LONGITUDE — DEG. WEST
105.5
106.0
106.5
107.0
107.5
NOMINAL WSMR BOUNDARIES
SHROUD
DESCENT STAGE
BOOSTER
ASCENT STAGE
LAUNCH SITE
LAUNCH ELEVATION: 86°
LAUNCH AZIMUTH: 356° TRUE
ABRES (BMRS) TRACT NO. 4
NOMINAL IMPACT POINTS
* METHOD OF ROOT MEAN SQUARES

Figure 4

LITTLE JOE II/LEM
ALTITUDE VS RANGE

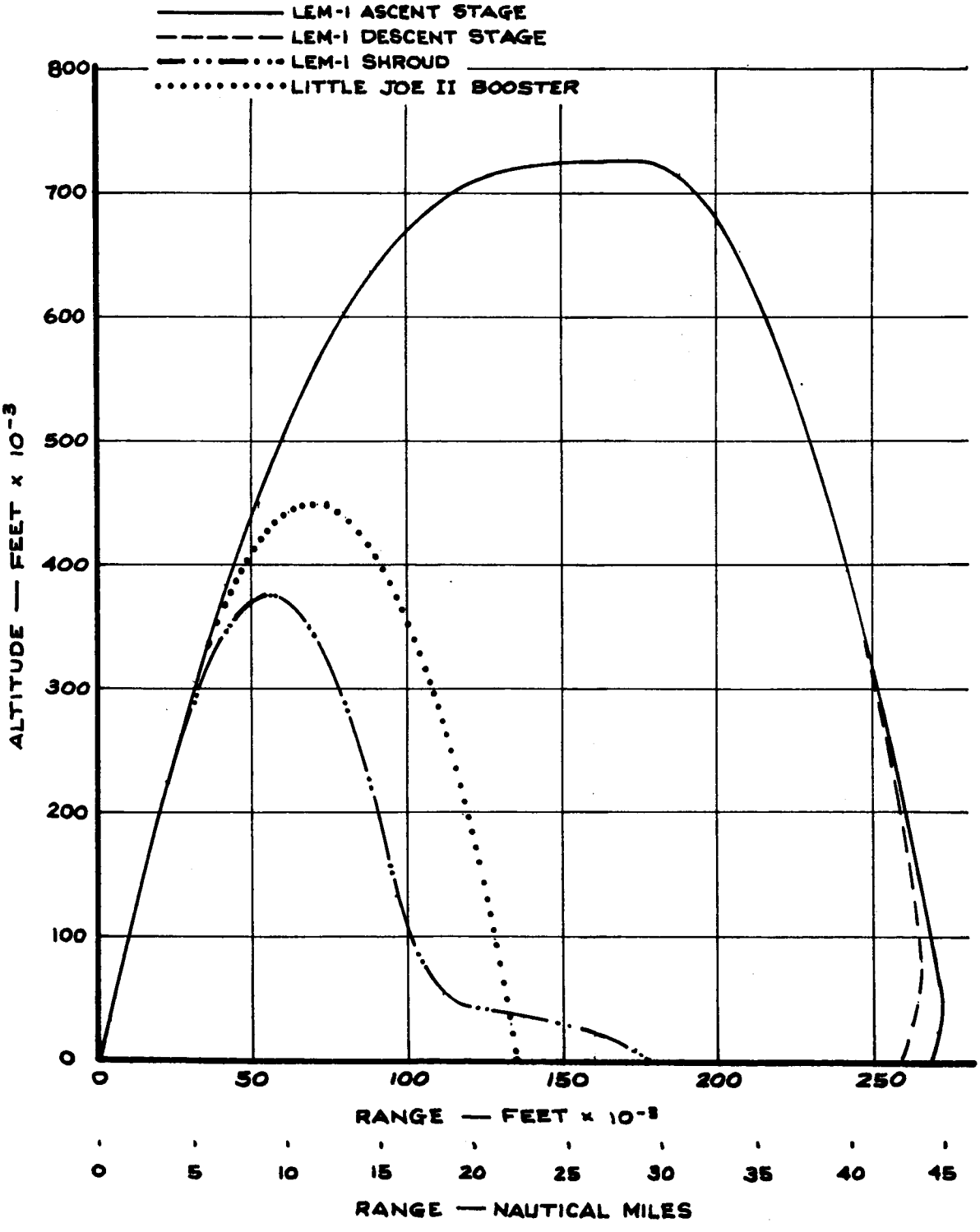


Figure 5

LITTLE JOE II / LEM
FLIGHT PARAMETERS

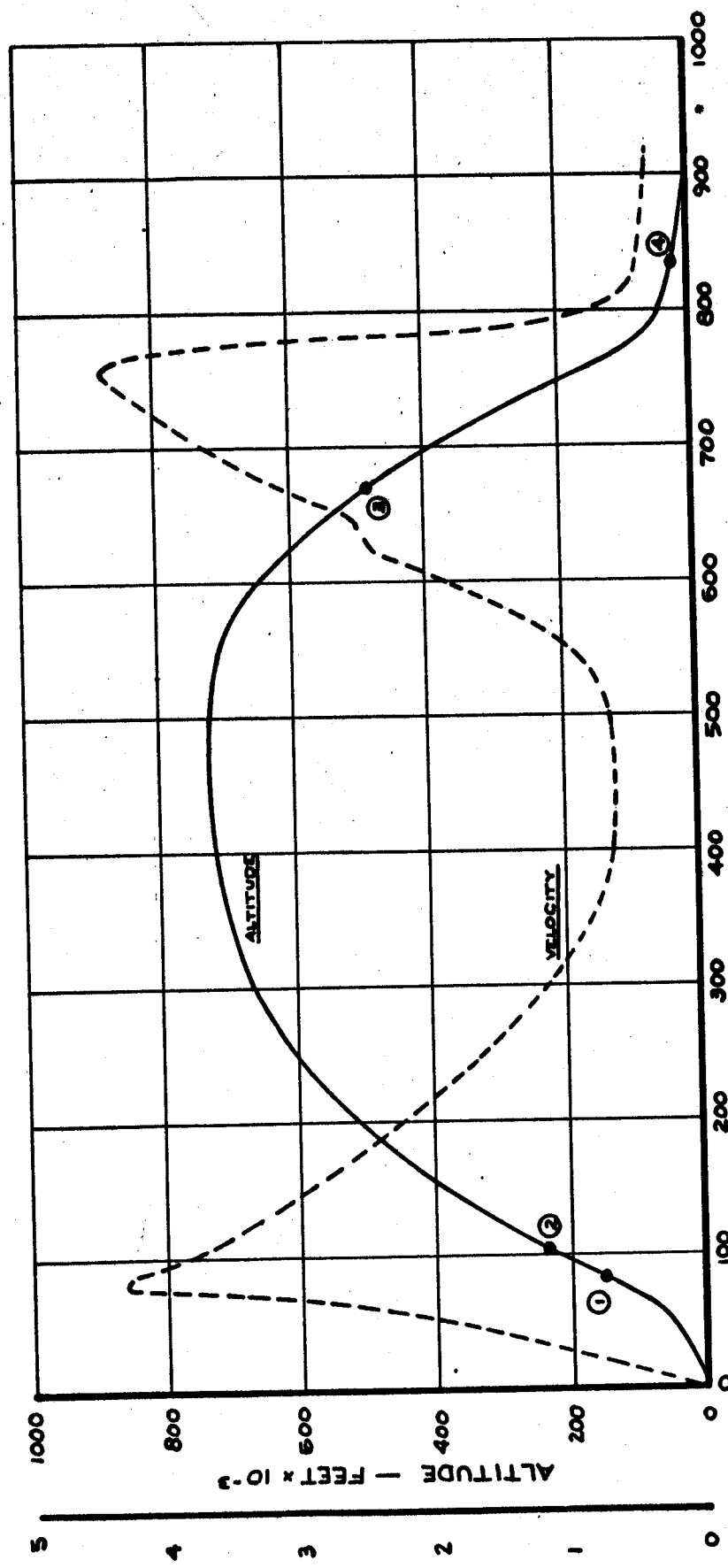


Figure 6a

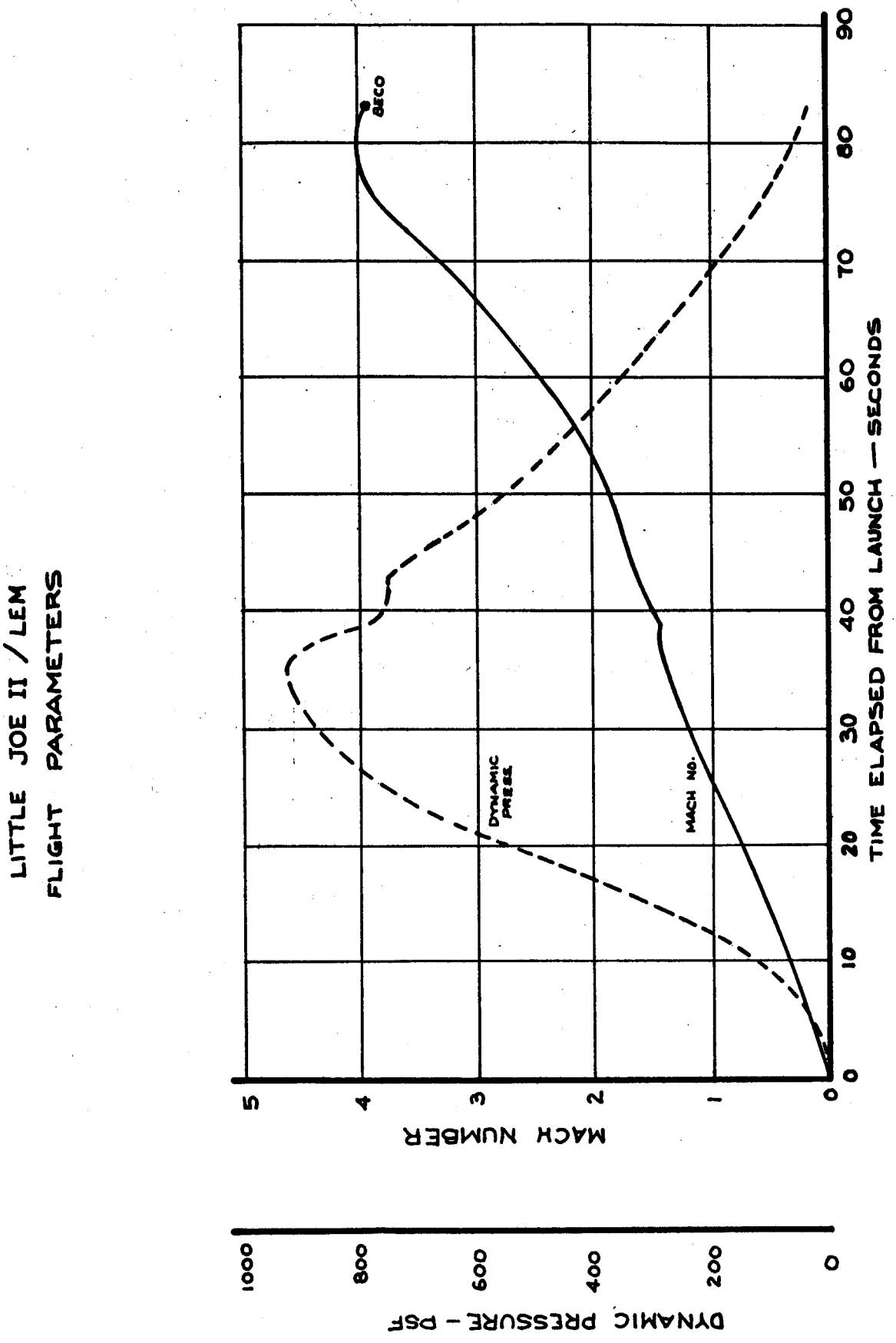

LITTLE JOE II / LEM
FLIGHT PARAMETERS
MACH NUMBER
5
4
3
2
1
0
DYNAMIC PRESSURE - PSF
1000
800
600
400
200
0
TIME ELAPSED FROM LAUNCH — SECONDS
0
10
20
30
40
50
60
70
80
90
BECO
DYNAMIC PRESS.
MACH NO.

Figure 6b

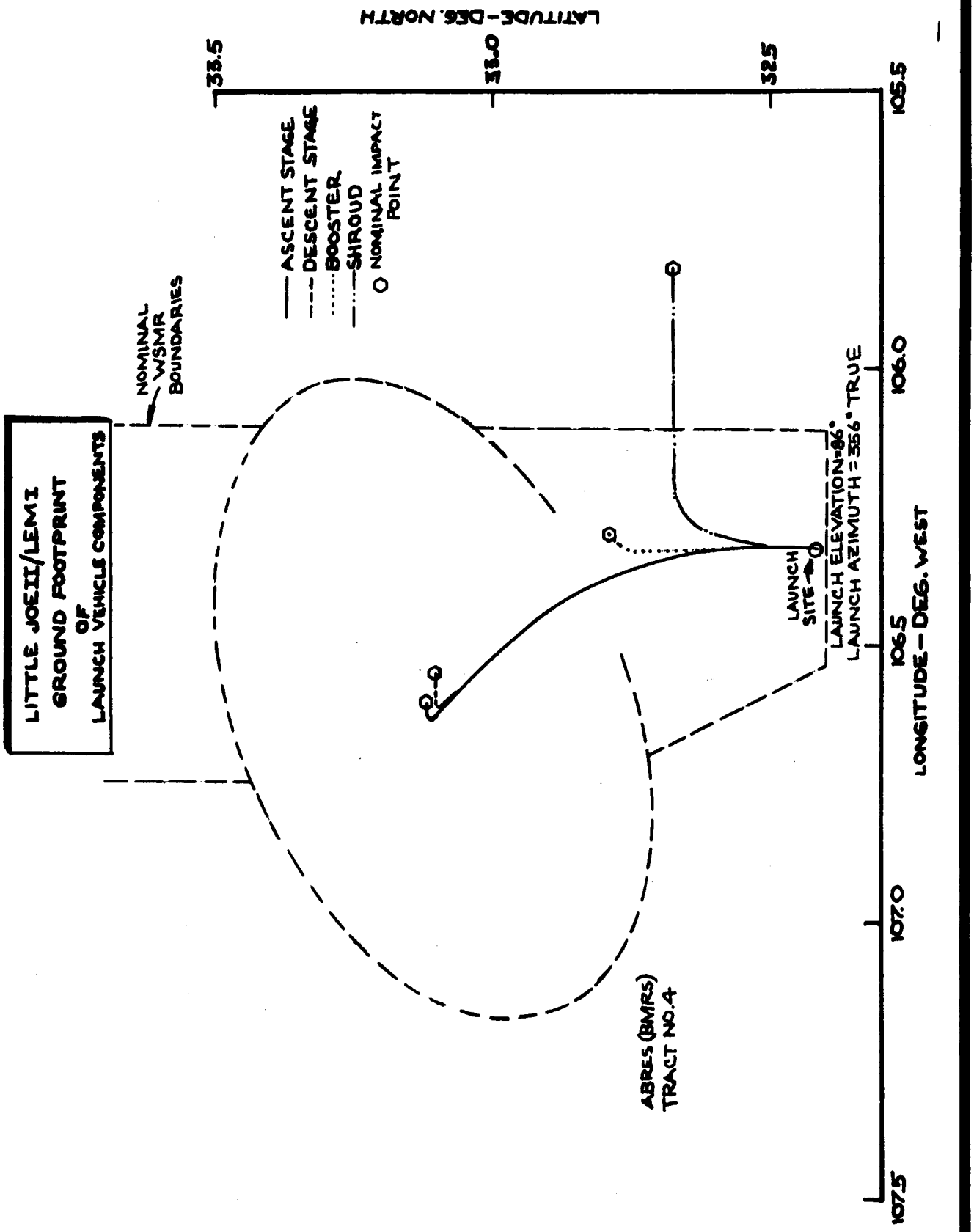

LATITUDE - DEG. NORTH
33.5
33.0
32.5
105.5
106.0
106.5
107.0
107.5
LONGITUDE - DEG. WEST
ASCENT STAGE
DESCENT STAGE
BOOSTER
SHROUD
NOMINAL IMPACT POINT
NOMINAL WSMR BOUNDARIES
LITTLE JOE II/LEM 1 GROUND FOOTPRINT OF LAUNCH VEHICLE COMPONENTS
LAUNCH SITE
LAUNCH ELEVATION=86°
LAUNCH AZIMUTH=356° TRUE
ABRES (BMRS) TRACT NO.4

Figure 7

LITTLE JOE II / LEM
CAMERA LOCATION

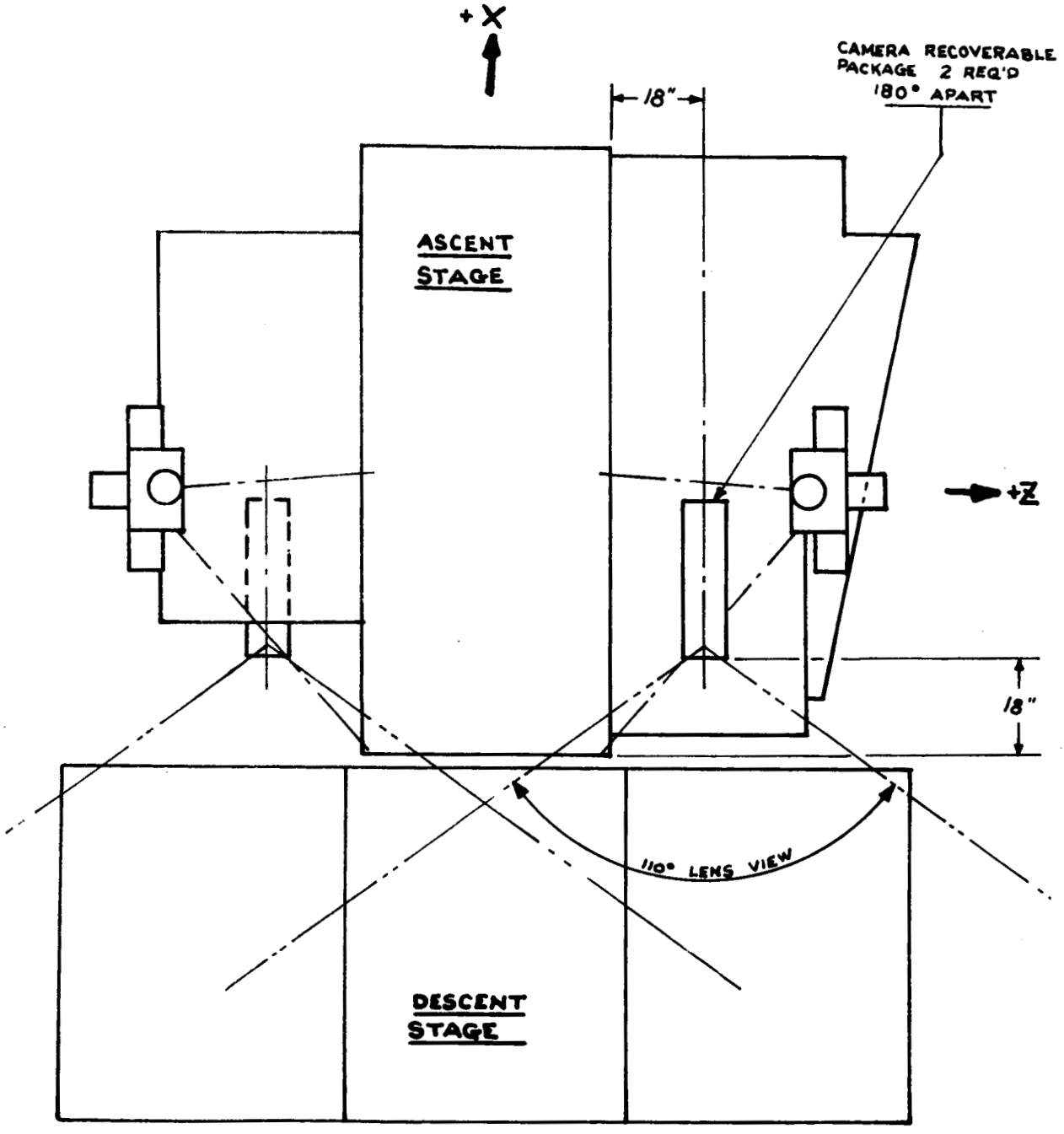


Figure 8a

LITTLE JOE II/LEM
CAMERA LOCATION

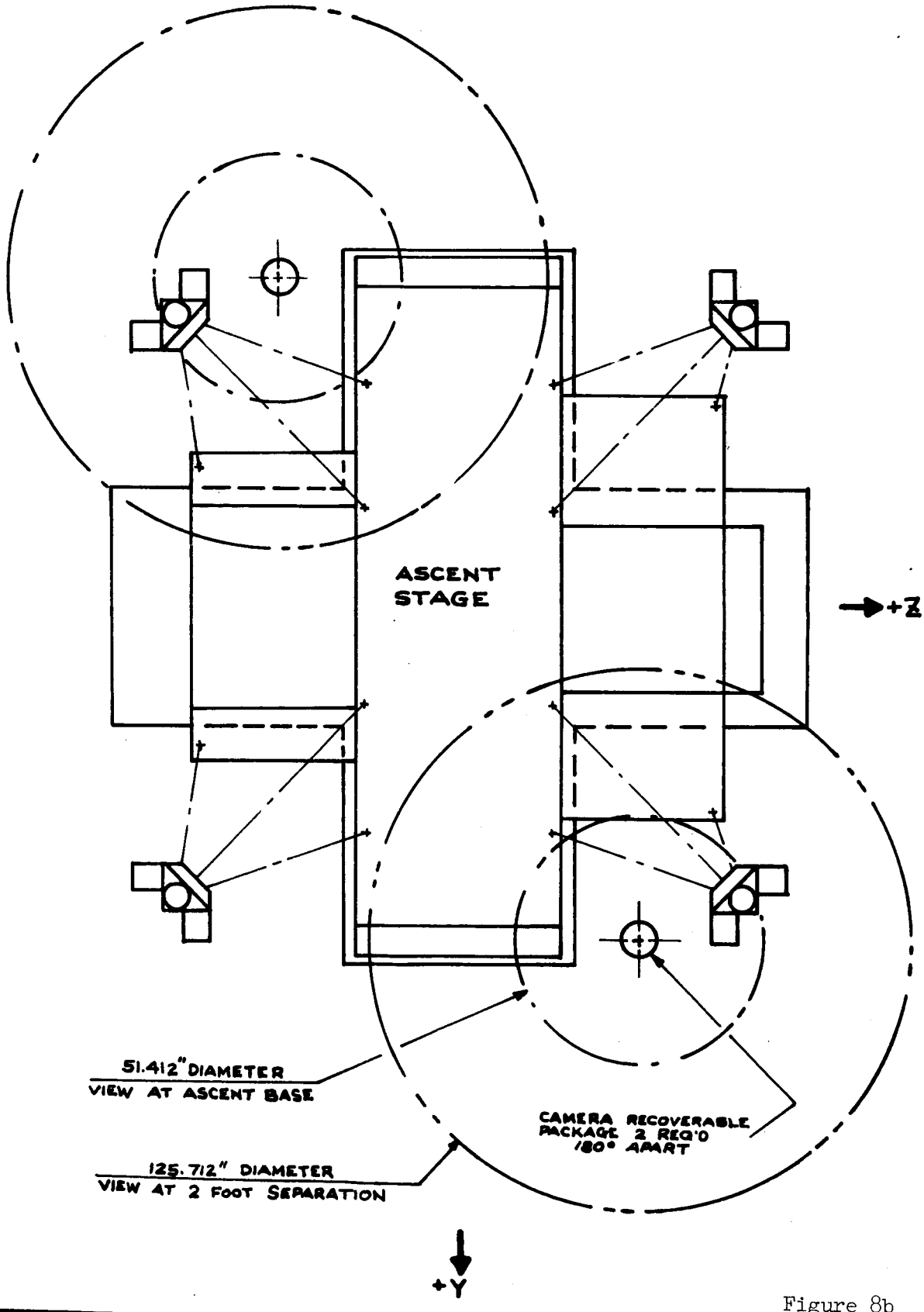


Figure 8b

TABLE I

NOMINAL ENGINE PERFORMANCE DATA

	Descent STL (1)	Descent RD (2)	Ascent Bell (3)
Engine weight (lbs)	350	350	131
Characteristic velocity, C* (ft/sec)	5595	5555	5508
Nominal specific impulse, Isp (sec)	311	307.6	311.6
Minimum Isp, 10% thrust, 3 (sec)	285	285	N.A.
Nominal thrust (lbs)	10,500	10,500	3,500
Minimum thrust (lbs)	1,050	1,050	N.A.
Throttling Method	Variable Area Injector	He Injection	None
Nominal chamber pressure (psia)	110	145	100
Chamber pressure at minimum thrust (psia)	11	14.5	N.A.
Nominal oxidizer flow (lbs/sec)	20.78	21.19	6.91
Oxidizer flow at 10% thrust, min Isp (lb/sec)	2.27	2.27	N.A.
Nominal fuel flow (lbs/sec)	12.98	13.24	4.32
Fuel flow at 10% thrust, min Isp (lb/sec)	1.42	1.42	N.A.
Nominal throat area (in^2)	54.4	40.4	19.2
Nozzle expansion ratio	49	53	40
Maximum gimbal range, pitch and yaw (deg)	6	6	N.A.
Maximum gimballing rate (deg/sec)	8	8	N.A.
Maximum gimballing acceleration (rad/sec2)	4	4	N.A.

N.A. Not applicable

(1) STL, Engine Characteristics Report, 8438-6021-SC000, 10/63

(2) Rocketdyne, LEM Descent Engine Characteristics Rpt. R-5270, 8/63

(3) Bell letter, LEM Ascent Engine Characteristics, S-136164, 8/63

TABLE II

ALGOL ID NOMINAL PERFORMANCE DATA

(At +70 °F and Sea Level Conditions)

(Data Given is for Canted Nozzle Version)

General Motor and Ballistic Characteristics

Loaded motor weight, lb.	22,000
Propellant weight, lb.	19,900
Expended motor weight, lb.	2,990
Nozzle weight, lb.	802
Inert parts weight, lb	2,978
Igniter weight, lb.	22
Characteristic velocity, ft/sec	5,011
C_w (Total burning time), lbm/lbf-sec	0.00642
Nozzle Expansion ratio	4.64
Throat area, sq. in.	175.33
Propellant weight fraction	0.859
Maximum thrust misalignment (calculated), degrees	0.2415
Over-all length, in.	357.61
Chamber diameter, in.	40.00
Storage Temperature limits, °F	+50 to + 90
Operating temperature limits, °F	+50 to + 90
Average thrust (web), lbs.	102,227
Average thrust (total), lbs.	95,100
Maximum thrust, lbs.	115,000
Impulse (web), lbs-sec.	3,671,675
Impulse (total), lbs-sec.	4,070,598
Specific Impulse (Over-all), (actual) lbs-sec/lbs.	214.4
Average pressure (web), psia	427.8
Average pressure (total), psia	400.6
Maximum pressure, psia	450.0
Propellant formulation	ANP-2639-AF
Ignition delay, sec.	TBD
Ignition interval, sec.	TBD
Web burning time, sec.	35.9
Total burning time, sec.	41.3
Burning rate, in/sec.	0.254
Weight flow rate, lb/sec.	450.8
C_f (total burning time)	1.376

General Motor and Ballistic Characteristics

Impulse to weight ratio, lbs-sec/lbs.	184.2
Ideal burnout velocity, ft/sec.	13,745
C. G. Loaded (calculated), in. aft of igniter boss	166.1
C. G. Expended (calculated), in. aft of igniter boss	214.2

Fuel Used - APN - 2639 AF (Ammonium perchlorate/polyuethane-aluminum)

TABLE III

INSTRUMENTATION REAL TIME READOUTS

Primary He leg pressure regulator discharge pressure

Secondary He leg pressure regulator discharge pressure

Fuel Quantity (descent stage)

Oxidizer Quantity (descent stage)

Engine Compartment Temperatures

Gimbal Position (Descent Engine)

Gimbal Position error signal (Descent Engine)

Chamber Pressure

Descent Engine Vibrations

LEM Attitude (three axis)

LEM three axis acceleration

WSMR Support Summary

RFWAR Title: Lem / Little Joe II
RFWAR No.

Phase: Development

User: NASA

Type of Test	Brief Test Title	Type of Test: Trk	Flt	Lab	Other	No. of Spec.	Test for Spec.	Schedule (o Arrive, ● Launch) Fy 65 1 2 3 4	Fy 66 1 2 3 4	Fy 67 1 2 3 4	Fy 68 1 2 3 4
II. (1)	LEM/Little Joe II QTV		x			1	1		o ●		
II. (2)	LEM-1		x			1	1		o ●		
II. (2)	LEM-2		x			1	1		o ●		

(1) Information presented in Section II bor the boost phase are applicable to the QTV flight.

Further details of QTV Flight will be provided upon formal acceptance of tests by NASA.

(2) Information provided in Section II is applicable to LEM-1, 2 tests.

(3) LEM-2 will remain at NASA/PSDF until LEM-1 has been launched.

REFERENCES

G.A.E.C. Report No. LPL-610-1, Feasibility Study and Detailed Test Plans for LEM - 1 and LEM - 2, 6 Sept. 1963

G.A.E.C. Report No. LPL-611-1, Detailed Test Plan for LEM - 1, 15 Nov. 1963

WSMR RFWAR No. 378R3 - Little Joe II authenticated 14 June 1963

WSMR Regulation No. 705-9, Research and Development of Material (RFWAR) 17 Jan. 1963

WSMR Circular No. 705-3, Missile Flight Surveillance 15 May 1962

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